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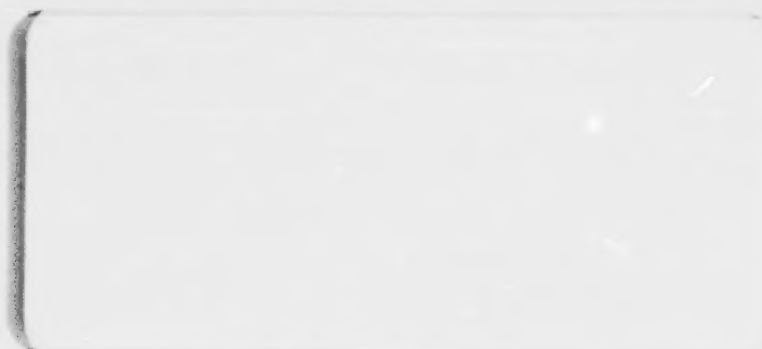
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DEPARTMENT OF ENVIRONMENT  
CONSERVATION AND PROTECTION  
ENVIRONMENTAL PROTECTION  
PACIFIC AND YUKON REGION

COMPILATION AND ASSESSMENT OF  
RESEARCH, MONITORING AND DUMPING  
INFORMATION FOR ACTIVE DUMP SITES ON  
THE BRITISH COLUMBIA AND YUKON  
COASTS FROM 1979 TO 1987

MANUSCRIPT REPORT: 87-02

Prepared for the Pacific Region Ocean Dumping  
Advisory Committee

By

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MARCH 1987

REVIEW NOTICE

This report has been reviewed by the Ocean Dumping Section, Environmental Protection, Conservation and Protection, and approved for publication. Approval does not necessarily signify that the comments reflect the views and policies of Environmental Protection. Mention of trade names or commercial products does not constitute recommendation or endorsement for use.

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ABSTRACT

Conservation and Protection has administered the requirements of the Ocean Dumping Control Act in the Pacific and Yukon Region since 13 December 1975.

Current authority to enforce the requirements that relate to the protection of fish, fish habitat and man's use of fish is exercised under subsection 33.1(1) of the Fisheries Act.

Activities related to ocean dumping in the Pacific Region were compiled in a report by Ward and Sullivan (1980).

This report is a continuation of that review and includes information on research and monitoring studies from 01 January 1980 to 01 January 1987.



### RÉSUMÉ

La direction générale de la Conservation et de la Protection administre les prescriptions de la Loi sur L'immersion de déchets en mer dans la région du Pacifique et du Yukon depuis le 13 décembre 1975.

Le pouvoir actuel de faire respecter les prescriptions se rapportant à la protection du poisson, à l'habitat du poisson et à l'usage que l'homme fait du poisson découle du paragraphe (1) de l'article 33 de la Loi sur les pêcheries.

Les activités se rapportant à l'immersion de déchets en mer dans la région du Pacifique sont expliquées dans le rapport de Ward et Sullivan (1980).

Le présent rapport est la suite de ce rapport; il contient des renseignements sur les recherches et les études effectuées du 1<sup>er</sup> janvier 1980 au 1<sup>er</sup> janvier 1987.

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## 1 INTRODUCTION

Conservation and Protection (formerly Environmental Protection Service) has administered the requirements of the Ocean Dumping Control Act in the Pacific and Yukon Region (Figure 1) since 13 December 1975.

A permit system was instituted to regulate the deliberate disposal of any substance from ships, aircraft, platforms and other man-made structures at sea and the disposal of substances considered harmful to the marine environment under special circumstances. Activities covered under the Act include experimental oil spills and stockpiling construction aggregates in a submarine location.

The Act does not apply to: disposal that is incidental to or derived from the normal operations of a ship or aircraft or of any equipment thereof; any discharge that is incidental to or derived from the exploration for, exploitation of, and associated off-shore processing of sea bed mineral resources; fuel dumping from aircraft; disposal into the sea from land based structures or outfalls; and the use of oil dispersants in environmental emergencies. A permit is not required when materials are placed in the sea for construction purposes ie: breakwaters, foreshore extension projects. Sidecast dredging during trench construction or burial of pipes or cables etc. may not require a permit under the O.D.C.A. if environmental concerns have been addressed under another licence or approval system.

In January 1984, the B.C. Court of Appeal found that section 4(1) of the Ocean Dumping Control Act was ultra vires of the federal parliament. The Court ruled that the disposal of substances into provincial marine waters was beyond the jurisdiction of the federal government. This ruling was partly based on the apparent lack of a linkage between ocean dumping and the authoritative powers given the federal government in provincial waters. These powers come under the heads of Navigation and Shipping, and Seacoast and Inland Fisheries. The B.C. Court ruling has been appealed to the Supreme Court of Canada. A ruling from this Court is expected sometime



FIGURE 1 LOCATION MAP

in 1987. In the interim, requirements of the Ocean Dumping Control Act that relate to the protection of fish, fish habitat and man's use of fish are being administered under the authority of subsection 33.1 (1) of the Fisheries Act. Until such time as the Supreme Court ruling is handed down, the Pacific and Yukon Region administration office continues 'business as usual' with the exception that 'Approvals' are issued rather than formal 'Permits' which have to appear in the Canada Gazette before becoming valid.

A review of historical and existing ocean dumping activity in the Pacific Region was compiled in 1980 (Ward and Sullivan, 1980). This report is a continuation of that review and includes all available information of ocean dumping incidents from 01 January 1980 to 01 January 1987.



## 2 DREDGING AND DUMPING ACTIVITIES

In British Columbia, the forest products industry continues to be the major source of material approved for ocean disposal. Woodwastes and sediments from forest products mills and log storage and sorting areas are removed to maintain loading and berthing facilities and navigable channels.

The maintenance of channels, harbours, marinas, bridges, wharves, ferry terminals and berthing areas to maintain acceptable depth constitutes the second major source of dredged materials. The Fraser River, particularly, requires periodic dredging which is handled primarily by Public Works Canada. Much of the dredge spoil for channel maintenance is disposed of at landfill sites; however, a significant amount is dumped at the Sandheads Dump Site in the Fraser River estuary. Public Works Canada also have spoil areas in-river and at the mouth of the North Arm.

The North Pacific Ocean Dump Site was created for the disposal of materials unacceptable for either coastal dump sites or landfill. To date, the site has been used twice with no apparent detrimental effect to the environment.

The Gabriola and Ballenas Basin Ocean Dump Sites have been approved for the disposal of derelict vessels. Since their designation, one vessel has been sunk at the Gabriola location.

Since 1980, a number of miscellaneous dumping incidents have occurred which should be noted. For the most part, these ocean dumping activities were related to foreshore development, marina construction or wharf expansion. In 1981, the B.C. Hydro and Power Authority Cheekeye-Dunsmuir submarine cable project involved a variety of ocean disposal sites between the mainland, Texada Island and Vancouver Island. The burial of sewage outfall lines at Ganges Harbour and Cape Lazo was completed in 1981 and 1982, respectively. Derelict vessels have been intentionally sunk at Porteau Cove in Howe Sound to provide a recreational scuba diving attraction. In 1980 and 1985, oil incineration tests were conducted in Howe Sound to determine the efficiency of this type of clean-up operation. The miscellaneous incidents of ocean disposal are discussed in more detail in section 5.2.

### 3 ENVIRONMENTAL ASSESSMENT

#### 3.1 Monitoring

A program of monitoring and assessment of the impact of ocean dumping activities on the marine environment is carried out routinely by Conservation and Protection. Prior to the promulgation of the Ocean Dumping Control Act, ocean disposal on the B.C. and Yukon coasts was widespread. Subsequent to the enactment, major ocean dump sites were designated in locations of least environmental impact which would accommodate most requirements of ocean dumping in any given area (Enclosure)

At each major ocean dump site, a monitoring grid has been established to facilitate successive sampling surveys. The studies evaluate cumulative impacts, if any, of the disposal of both contaminated and clean dredge material by measuring trace metal concentrations in benthic sediments. Biological sampling and Pisces IV dive observations have also been used in the environmental assessment. Results of surveys conducted from 1980 - 1986 are discussed in detail under specific ocean dump site headings in Section 5.2.

The trace metal concentrations in benthic sediments were analyzed by the D.O.E./D.F.O. Chemistry Laboratory in West Vancouver (W.V.L.). Detailed analytical procedures for samples and quality assurance information can be obtained from Mr. P. Kluckner, Manager, Laboratory Services, 4160 Marine Drive, West Vancouver, B.C. V7V 1N6.

The raw data represent a single analysis for each sample after drying and homogenizing. Copper, lead and zinc were analyzed using Inductively Coupled Argon Plasma Atomic Emission (ICAP-AE). Cadmium, prior to August, 1984, was analyzed by ICAP-AE. Subsequently, results for low level cadmium were determined by Graphite Furnace Atomic Absorption (GFAA). Mercury analysis was by flameless Atomic Absorption. Quality assurance data for accuracy represented by analysis of certified reference material (MESS-1, BCSS-1) is reported where available. The replicates



for precision data and a complete heavy metal scan are not included but are available on request.

In addition to the ocean dump site monitoring programs, pre-dredge monitoring surveys have been conducted at specified loadsites which have either not been sampled previously or are suspected to have trace metal concentrations in the sediments in excess of O.D.C.A. guideline levels. The findings of these investigations, where available, are discussed under Loadsite Information in section 5.2.

### 3.2 Research

In addition to the periodic monitoring programs conducted by Conservation and Protection, the National Ocean Dumping Control Act Research Fund (O.D.C.A.R.F.) was created to support research projects which would aid in understanding the impact of ocean disposal on the marine environment, long term environmental implications, ocean disposal techniques, analysis techniques and other concerns to most effectively administer the O.D.C.A.

Where applicable, the results of these research studies are discussed under Research Information in section 5.2.

#### 4 ADMINISTRATION OF THE OCEAN DUMPING CONTROL ACT

##### 4.1 Ocean Dumping Application

Under the Ocean Dumping Control Act, all materials to be dumped and/or loaded for the purpose of dumping at sea require a permit (approval). Application forms and additional information including a guide to the Ocean Dumping Control Act and a copy of the Act and Regulations are available from Conservation and Protection, Kapilano 100, Park Royal, West Vancouver, B.C. V7T 1A2.

Application forms containing all pertinent information are submitted to the Permit Issuing Office where they are recorded on a National database system and distributed to various Federal and Provincial agencies for review. The final assessment and evaluation for each application is conducted by the Regional Ocean Dumping Advisory Committee (R.O.D.A.C.) which decides whether or not ocean disposal will be allowed. This committee is comprised of three scientists who represent Conservation and Protection (R.O.D.A.C. chairmen) and the Department of Fisheries and Oceans (West Vancouver Laboratory, and the Institute of Ocean Sciences.) Based on the recommendations of R.O.D.A.C., final approval is indicated by the signature of the Director of Conservation and Protection, Pacific and Yukon Region.

Should the application receive approval, various conditions are stipulated, such as timing restrictions, load and dump site locations, quantity and type of material to be dumped, method of release, reporting requirements and occasionally monitoring requirements. Approvals are valid for a maximum period of one year.

##### 4.2 Restrictions on Dredging and Ocean Dumping

The Department of Fisheries and Oceans imposes timing restriction for dredging and dumping between various specified dates at certain locations on the coast. These restrictions are designed to ensure that the fisheries resources of a particular area are protected during sensitive periods. In the Lower Fraser River, clamshell dredging is subject to a

site-specific review during the period March 1 to July 30. It is recommended that dredging of organic sediments (containing woodwastes) be scheduled during the period August 1 to March 1. In Vancouver Harbour and Burrard Inlet dredging is generally prohibited from June 1 to July 15 to protect salmonids released from the Capilano Hatchery. It is recommended that clamshell dredging be scheduled from August 1 to March 1 in this area.

In accordance with the Ocean Dumping Control Act, certain substances are prohibited or restricted from ocean disposal. The substances listed in Schedule I of the Act are generally prohibited when present at concentrations exceeding those specified below unless, in the opinion of the Minister, the substance will be rapidly rendered harmless by physical, chemical or biological processes of the sea at the dumpsite:

- a) organohalogen compounds, quantities shall not exceed 0.01 parts of a concentration shown to be toxic to marine animal and plant sensitive organisms in a bioassay sample and test carried out in accordance with procedures established or approved by the Minister; 'In the absence of a specified test and procedures, O.D.C.A. managers have adopted a screening guideline of 0.1 to 1.0 ug/g dry weight in the solid phase. This guideline level applies to polychlorinated biphenyl (P.C.B.) and chlorophenols (P.C.P. and T.C.P.) in sediments.'
- b) mercury and mercury compounds in a solid phase of a waste, 0.75 milligrams per kilogram, and in the liquid phase of a waste, 1.5 milligrams per kilogram;
- c) cadmium and cadmium compounds in a solid phase of a waste, 0.6 milligrams per kilogram and in the liquid phase of a waste, 3.0 milligrams per kilogram; '0.6 concentration in solid phase is used as a screening limit only.'
- d) persistent plastics and other persistent synthetic materials, four per cent by volume, in a suitably comminuted form;
- e) crude oil, fuel oil, heavy diesel oil and lubricating oils,

quantity that yields more than 10.0 milligrams per kilogram of n-hexane soluble substances; 'For oil and oil compounds the 10.0 milligrams per kilogram refers to these substances found in the liquid phase and is based on best practicable technology. In sediments 1 000 to 1 500 ug/g dry weight has been adopted by program managers for screening purposes.'

- f) high level radioactive wastes or other high level radioactive matter that may be prescribed;
- g) substances in whatever form produced for biological and chemical warfare.

In Schedule II, the following substances are restricted when present in significant amounts. Substances listed in b) and h) below, ie: lead and pesticides, are considered to be present in significant amounts when contained in wastes at concentrations of 0.05% or more by weight (ie: 500 ug/g). All other substances listed in Schedule II are regarded as present in significant amounts at concentrations of 0.1% or more (ie: 1 000 ug/g).

- a) arsenic and its compounds;
- b) lead and its compounds;
- c) copper and its compounds;
- d) zinc and its compounds;
- e) organosilicon and its compounds;
- f) cyanides;
- g) fluorides;
- h) pesticides and their by-products not included in Schedule I;
- i) beryllium and its compounds;
- j) chromium and its compounds;
- k) nickel and its compounds;
- l) vanadium and its compounds;
- m) containers and scrap metal;
- o) radioactive wastes or other radioactive matter not included in Schedule I;

- p) substances that by reason of their bulk would interfere with fishing.

#### 4.3      Enforcement

Conservation and Protection is responsible for enforcement of the conditions of the Ocean Dumping Control Act. Ocean Dumping Inspectors conduct periodic inspections and surveillance to ensure that dredging/loading and dumping operations are carried out in accordance with the conditions outlined in the issued approval. Any contravention of these conditions would be dealt with under the authority of the Fisheries Act, subsection 33.1(1).

## 5 PACIFIC AND YUKON OCEAN DUMP SITES

### 5.1 Index of Pacific and Yukon Ocean Dump Sites

The Pacific and Yukon ocean dump sites utilized since 1980 are listed in the following four sub-sections. In the interest of continuity, the same numbering system used in Ward and Sullivan (1980) to designate the dump sites has been maintained in this report. An alphabetic listing of dump sites used since 1980 can be found in Appendix III. A numeric listing of historical and existing dump sites can be found in Appendix IV. The Pacific and Yukon coastlines have been divided into geographic areas to catalogue the incidents of ocean dumping.

- Southern Vancouver Island and B.C. South Coast (Figure 2)
- Northern Vancouver Island and B.C. Central Coast  
(Figure 3)
- Queen Charlotte Islands and B.C. North Coast (Figure 4)
- Miscellaneous Dumping (Figures 5, 6 & 7)

5.1.1 Southern Vancouver Island and B.C. South Coast.

| <u>Number</u> | <u>Site</u>                 | <u>Co-ordinates</u>                              | <u>Depth<br/>(m)</u> | <u>Page</u> |
|---------------|-----------------------------|--------------------------------------------------|----------------------|-------------|
| 1             | Point Grey                  | 49°15.40'N 123°22.10'W                           | 210                  | 23          |
| 8             | PWC Spoil Area 8 & 8A       | 49°15.70'N 123°17.30'W<br>49°16.40'N 123°16.70'W | 18<br>5              | 31          |
| 9             | Sand Heads                  | 49°06.00'N 123°19.50'W                           | 70                   | 32          |
| 9A            | Sand Heads PWC Spoil Area 1 | 49°06.10'N 123°18.30'W                           | 27                   | 35          |
| 14            | Victoria                    | 48°12.30'N 123°21.80'W                           | 90                   | 36          |
| 18            | Haro Strait                 | 48°41.00'N 123°16.40'W                           | 200                  | 43          |
| 32            | Porlier Pass                | 49°00.20'N 123°29.80'W                           | 200                  | 47          |
| 40            | Five Finger                 | 49°15.20'N 123°54.60'W                           | 280                  | 53          |
| 44            | French Creek                | 49°22.50'N 124°19.00'W                           | 200                  | 58          |
| 48            | Comox                       | 49°41.70'N 124°44.50'W                           | 190                  | 59          |
| 49            | Malaspina Strait            | 49°45.00'N 124°27.00'W                           | 320                  | 60          |
| 64            | Thornbrough Channel         | 49°31.00'N 123°28.20'W                           | 220                  | 69          |
| 65            | Watts Point                 | 49°38.50'N 123°14.00'W                           | 230                  | 75          |
| 107           | North Pacific Ocean         | 49°25.00'N 126°20.00'W                           | 1 000                | 83          |
| 112           | Vancouver Hbr. Incinerator  | 49°17.20'N 123°05.80'W                           | 0                    | 90          |
| 113           | Gabriola                    | 49°08.00'N 123°32.00'W                           | 360                  | 91          |
| 114           | Thormanby Island            | 49°27.50'N 124°04.50'W                           | 384                  | 95          |
| 115           | Ballenas Basin              | 49°23.50'N 123°58.00'W                           | 400                  | 100         |



5.1.2 Northern Vancouver Island and B.C. Central Coast.

| <u>Number</u> | <u>Site</u>                        | <u>Co-ordinates</u>    | <u>Depth<br/>(m)</u> | <u>Page</u> |
|---------------|------------------------------------|------------------------|----------------------|-------------|
| 116           | Cape Mudge                         | 49°57.70'N 125°05.00'W | 145                  | 109         |
| 75            | Kingcome Inlet                     | 50°55.00'N 126°13.00'W | 125                  | 115         |
| 79            | Port Alice                         | 50°22.70'N 127°26.60'W | 50                   | 116         |
| 83            | Tahsis Inlet                       | 49°51.60'N 126°39.60'W | 200                  | 117         |
| 86            | Newcombe Channel                   | 48°54.70'N 125°29.30'W | 60                   | 123         |
| 145           | Ucluelet                           | 48°53.60'N 125°32.50'W | 100                  | 124         |
| 88            | Port Alberni                       | 49°12.00'N 124°49.30'W | 45                   | 131         |
| 117           | Muchalat Inlet                     | 49°39.00'N 126°14.90'W | 370                  | 152         |
| 118           | Eliza Passage                      | 49°40.80'N 126°34.30'W | 200                  | 157         |
| 119           | Johnstone Strait<br>-Hickey Point  | 50°27.80'N 126°04.80'W | 270                  | 162         |
| 120           | Johnstone Strait<br>-Hanson Island | 50°33.50'N 126°48.00'W | 470                  | 163         |
| 121           | Malcolm Island                     | 50°42.00'N 127°06.00'W | 180                  | 167         |

5.1.3 Queen Charlotte Islands and B.C. North Coast.

| <u>Number</u> | <u>Site</u>           | <u>Co-ordinates</u>    | <u>Depth<br/>(m)</u> | <u>Page</u> |
|---------------|-----------------------|------------------------|----------------------|-------------|
| 93            | Kitimat Arm           | 53°58.00'N 128°41.50'W | 176                  | 172         |
| 98            | Prince Rupert Harbour | 54°22.10'N 130°15.70'W | 53                   | 176         |
| 100           | Brown Passage         | 54°18.70'N 130°45.00'W | 180                  | 178         |

5.1.4 Miscellaneous Dumping.

| <u>Number</u> | <u>Site</u>                             | <u>Co-ordinates</u>    | <u>Depth<br/>(m)</u> | <u>Page</u> |
|---------------|-----------------------------------------|------------------------|----------------------|-------------|
| 92            | North Bentinck Arm                      | 52°23.00'N 126°49.00'W | 200                  | 180         |
| 97            | Porpoise Harbour                        | 54°14.50'N 130°18.50'W | 1                    | 180         |
| 122           | Burrard Inlet-Roche Point               | 49°17.50'N 122°57.60'W | 20                   | 180         |
| 123           | Vancouver Harbour-NHB Site              | 49°17.20'N 123°06.40'W | 1                    | 181         |
| 124           | Dillingham Site                         | 49°18.00'N 123°02.40'W | 15                   | 181         |
| 125           | False Creek                             | 49°16.50'N 123°06.30'W | 5                    | 181         |
| 126           | Roberts Bank -<br>Strait of Georgia     | 49°00.70'N 123°10.50'W | 40                   | 182         |
| 127           | McNeill Bay -<br>Strait of Juan de Fuca | 48°24.60'N 123°18.30'W | 1                    | 182         |
| 128           | Swartz Bay                              | 48°41.00'N 123°24.50'W | 1                    | 182         |
| 129           | Ganges Harbour                          | 48°50.10'N 123°26.40'W | 1                    | 183         |
| 131           | Lambert Channel -<br>Hornby Island      | 49°30.10'N 124°41.20'W | 30                   | 183         |
| 132           | Cape Lazo                               | 49°42.00'N 124°50.00'W | 1                    | 183         |
| 133           | Little River -<br>Strait of Georgia     | 49°46.50'N 124°47.00'W | 340                  | 184         |
| 134           | Beaver Cove                             | 50°32.00'N 126°51.60'W | 18                   | 184         |
| 135           | Malaspina Hulks                         | 49°51.80'N 124°33.40'W | 36                   | 184         |
| 136           | Texada Island -<br>Cape Cockburn        | 49°40.40'N 124°12.20'W | 1                    | 185         |
|               | Texada Island (West)                    | 49°35.40'N 124°21.30'W | 1                    |             |
|               | Texada Island (East)                    | 49°38.00'N 124°17.00'W | 1                    |             |
|               | Nile Creek                              | 49°25.40'N 124°38.50'W | 1                    |             |

5.1.4 (Continued)

| <u>Number</u> | <u>Site</u>                      | <u>Co-ordinates</u>                              | <u>Depth<br/>(m)</u> | <u>Page</u> |
|---------------|----------------------------------|--------------------------------------------------|----------------------|-------------|
| 137           | Gibson's Harbour                 | 49°23.90'N 123°30.20'W                           | 1                    | 185         |
| 138           | Porteau Cove Provincial<br>Park  | 49°33.00'N 123°14.00'W                           | 9                    | 186         |
| 139           | Howe Sound Incineration<br>Site  | 49°29.80'N 123°28.60'W                           | 9                    | 186         |
| 140           | Queen Charlotte Strait           | 50°46.40'N 127°22.60'W                           | 390                  | 186         |
| 141           | Browning Entrance                | 53°44.00'N 130°32.00'W<br>53°40.00'N 130°40.00'W | 40                   | 187         |
| 142           | Hartley Bay -<br>Douglas Channel | 53°25.20'N 129°14.40'W                           | 250                  | 187         |
| 143           | Yakoun River                     | 53°40.00'N 132°13.00'W                           | 1                    | 187         |
| 110           | Observatory Inlet                | 55°53.00'N 130°00.60'W                           | 146                  | 188         |
| 144           | Shingle Point, Y.T.              | 69°03.00'N 137°15.00'W                           | 3                    | 188         |



FIGURE 2 PACIFIC AND YUKON REGION OCEAN DUMPSITES - SOUTHERN VANCOUVER ISLAND AND BRITISH COLUMBIA SOUTH COAST

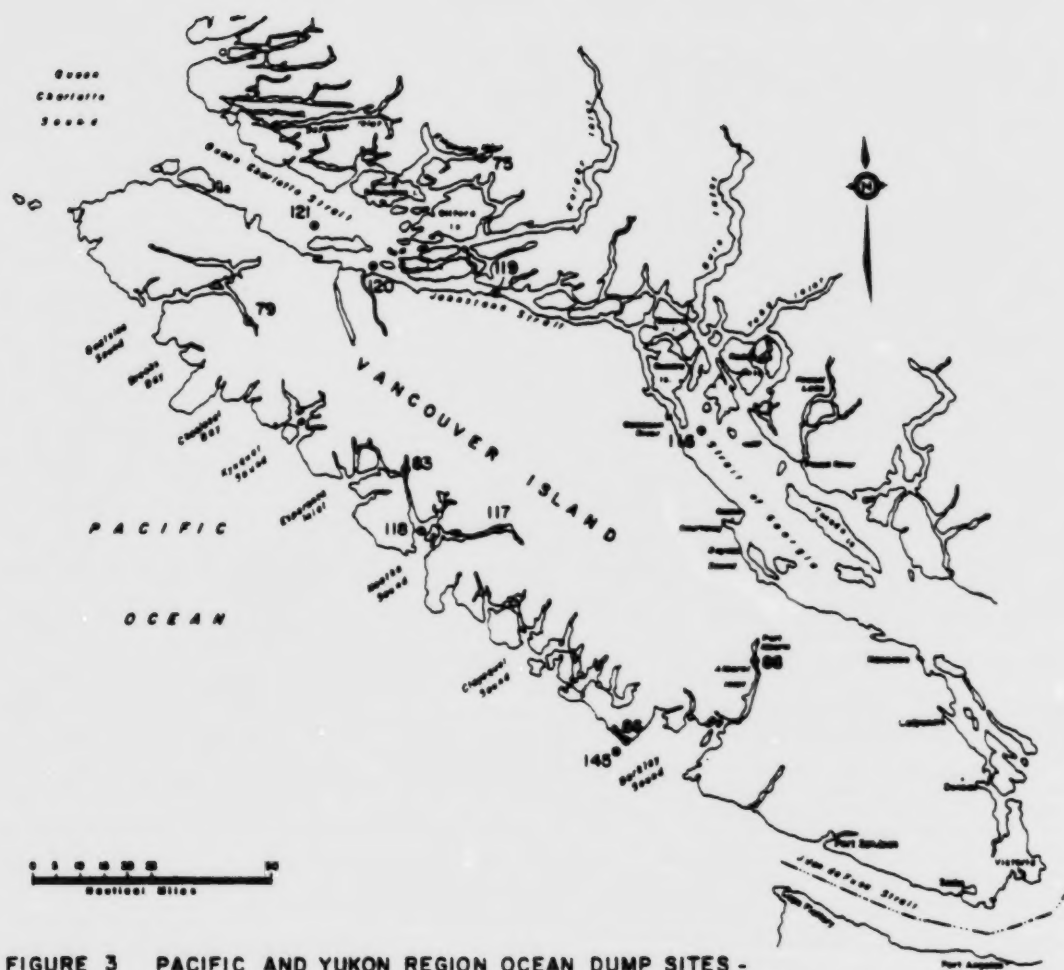


FIGURE 3 PACIFIC AND YUKON REGION OCEAN DUMP SITES -  
NORTHERN VANCOUVER ISLAND AND BRITISH COLUMBIA  
CENTRAL COAST

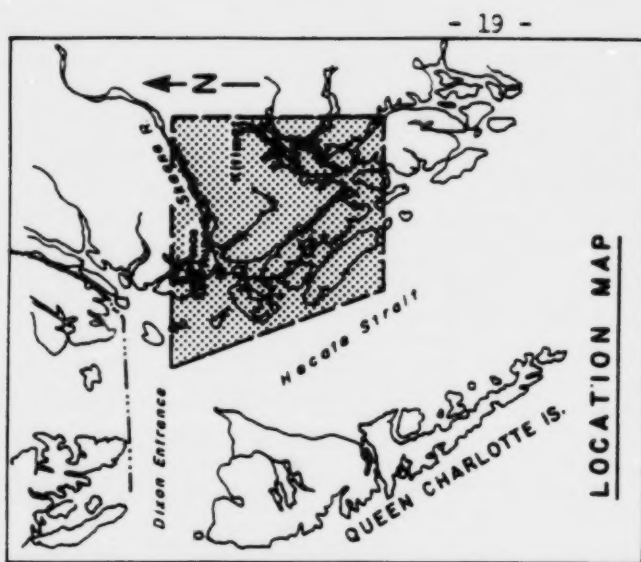
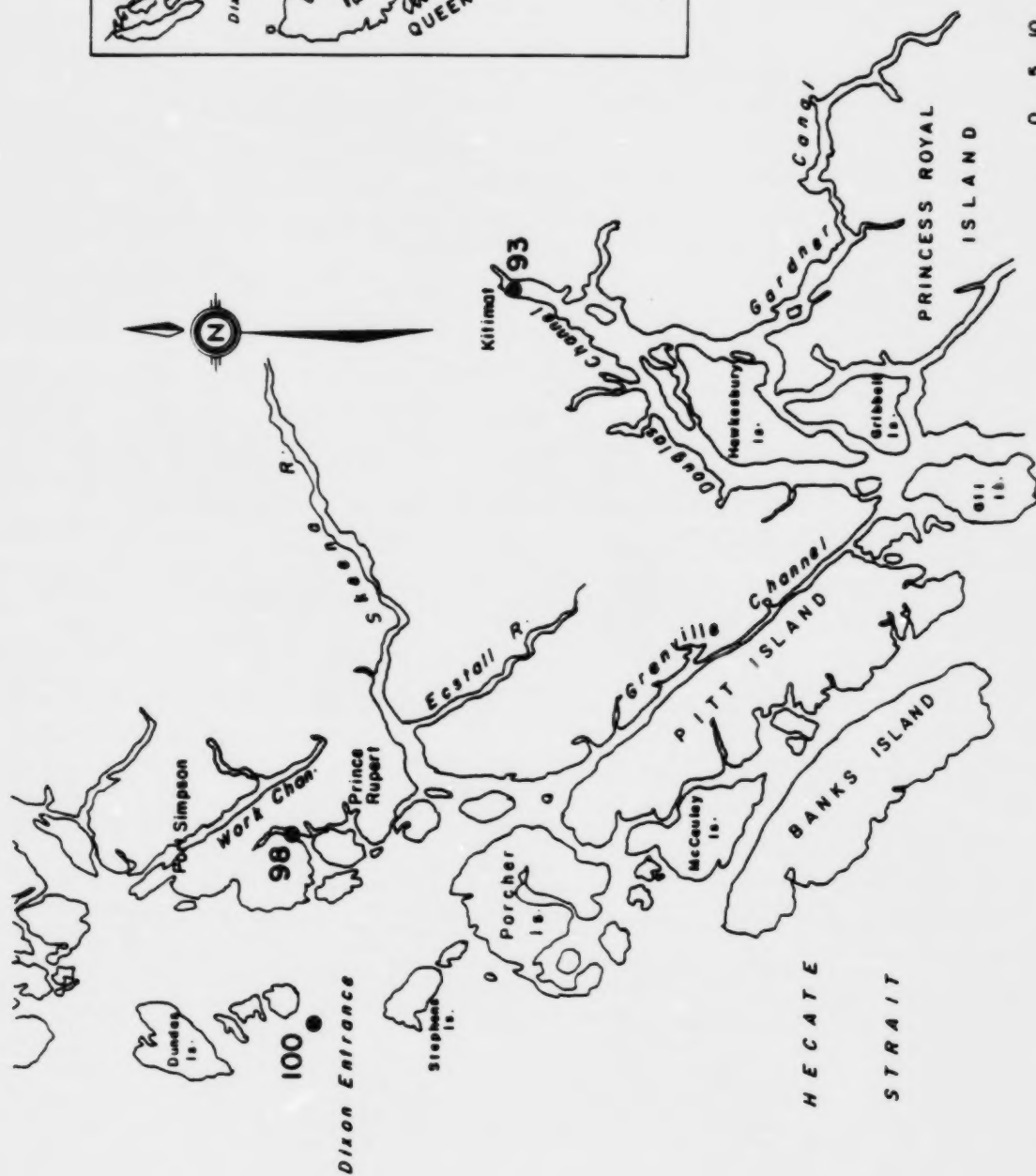


FIGURE 4 PACIFIC AND YUKON REGION OCEAN DUMPSITES - BRITISH COLUMBIA NORTH COAST



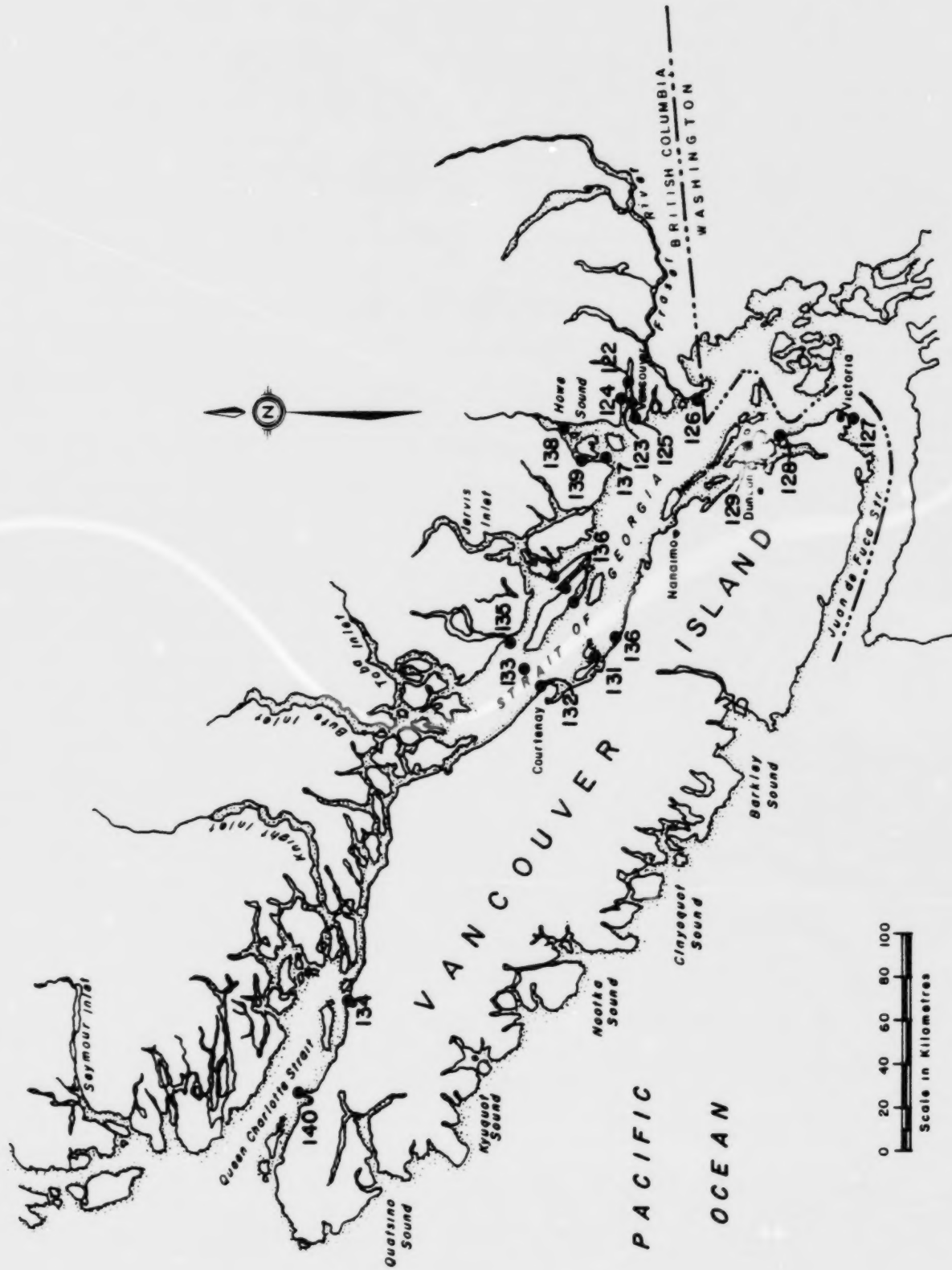


FIGURE 5 MISCELLANEOUS DUMPING INCIDENTS - BRITISH COLUMBIA SOUTH COAST



FIGURE 6 MISCELLANEOUS DUMPING INCIDENTS - BRITISH COLUMBIA NORTH COAST

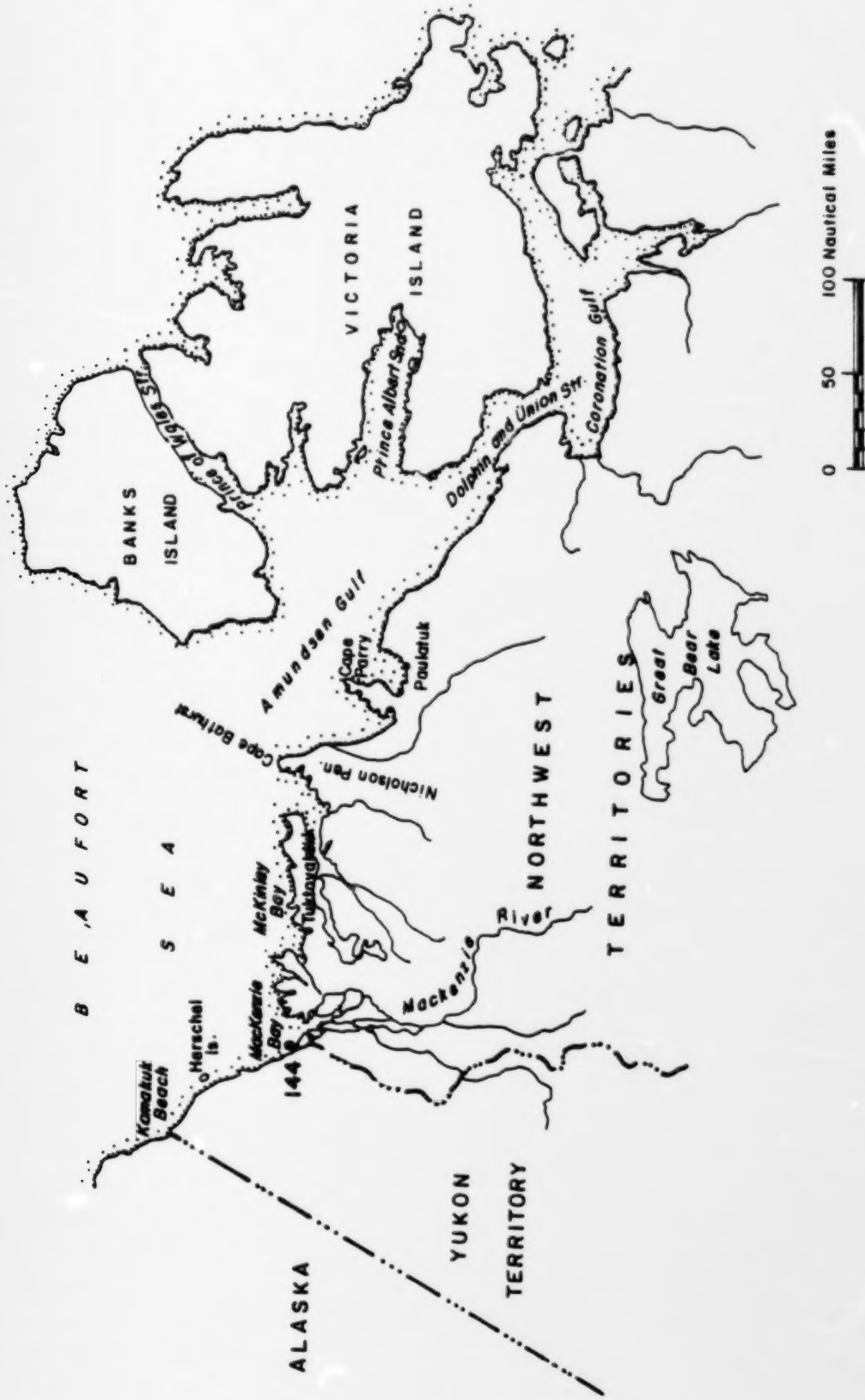


FIGURE 7 MISCELLANEOUS DUMPING INCIDENTS - YUKON TERRITORY / BEAUFORT SEA

## 5.2 Dump Site Information

The total quantity of dumped material found under dump site headings in the following section is the total amount dumped under approval since 1976. Any discrepancy between totals reported in Ward and Sullivan (1980) would be known amounts dumped prior to the O.D.C.A.

Information on specific approvals at each dump site can be found in Appendix I. Unless otherwise noted, the material discharged was dredged material consisting of wood, wood debris, sand, silt, gravel, mud, etc.

### 5.2.1 Southern Vancouver Island and B.C. South Coast.

|                |                        |
|----------------|------------------------|
| DUMPSITE:      | <u>POINT GREY</u>      |
| NUMBER:        | 1                      |
| CO-ORDINATES:  | 49°15.40'N 123°22.10'W |
| DEPTH:         | 210                    |
| TOTAL QUANTITY |                        |
| DUMPED:        | 3 047 444 cubic metres |
| COMMENTS:      |                        |

This dumpsite was designated by Ministry of Transportation in 1968. It continues to be the most frequently used dumpsite in the Pacific Region.

#### LOADSITE INFORMATION:

Material dumped at the Point Grey dump site originates from areas of extensive residential and industrial use in the B.C. lower mainland. The largest volume of spoils originates from forest industry sites on the Fraser River where routine dredging is required to maintain adequate water depth for various shoreline activities. A large proportion of woodwastes are contained in these spoils, however, chemical contamination is seldom found.

In Vancouver Harbour there are a variety of sites which require maintenance dredging and which are potential sources of contaminated material. These sites include: ore concentrate loading docks; ship building and repair facilities; bulk loading terminals; grain terminals; chemical plants; and public and commercial boat moorage areas. In addition to the disposal of marine sediments, soils from a number of excavation sites in the Greater Vancouver area have been dumped at the Point Grey site. These soils may or may not be contaminated depending on the historical use of the excavated area.

The False Creek area has a history of industrial use and waste disposal which has resulted in elevated concentrations of several contaminants in the surface marine sediments. A significant volume of these sediments was dumped at Point Grey dump site in the early 1970's when the south side of the Creek was restored for residential use.

In later years, the B.C. Place and Expo '86 developments required dredging and disposal of a large volume of contaminated surface sediments. In 1982 a core sampling survey was designed and initiated jointly by Environmental Protection and B.C. Place Ltd. to define the distribution of trace metals and organics in False Creek (Brothers and Sullivan, 1984). The sediments containing unacceptable levels of contaminants were dumped at the North Pacific Ocean dump site ( no. 107) and the underlying clean material went to the Point Grey site. Sampling and chemical analyses are often a pre-dredging requirement for proposed operations in Vancouver Harbour and False Creek. Areas of concern or 'hot spots' in the Harbour and the possible effects on resident marine animals are discussed in 'Initial Environmental Assessment Profile of Vancouver Harbour' prepared for Environmental Protection in 1985 (Waters 1985). The Department of Fisheries and Oceans (D.F.O.) recommends that dredging/loading of organic sediments (ie: containing woodwastes, etc.) be scheduled during the period August 1 to March 1. Clamshell dredging will be subject to a site-specific review during the period March 1 to August 1 to avoid interference with eulachon and juvenile salmon utilization of the Fraser River, and salmon and other fishery resource utilization of Vancouver Harbour and Burrard Inlet. Suction dredging is subject to the D.F.O. Fraser River Dredging Guidelines. Dredging of organic sediments is normally prohibited in Vancouver Harbour during the period June 1 to July 15 to protect juvenile salmon released from the Capilano Hatchery.

#### RESEARCH INFORMATION:

In 1985, a contract was awarded for assessing the usefulness of data generated in past studies into the environmental effects of dredge spoil

disposal at the Point Grey site (O.D.C.A.R.F. no. 11.2.2). It was generally felt that the modifications made to the routine monitoring program over the last ten years made the analysis and interpretation of spatial and temporal trends difficult. The report recommended the establishment and maintenance of a program incorporating; sediment bioassays, benthic infaunal sampling and physical/chemical sediment analysis. Although the advantages of such a program are obvious, the location and water depth of the dump site would make the undertaking quite expensive.

In-situ research studies involving biological tissue collection and sediment bioassays have been conducted at the dump site (O.D.C.A.R.F. no.'s 4.2.5A, 4.2.5B and 11.2.4). Laboratory studies to determine the bioaccumulation potential of contaminants from Vancouver Harbour and False Creek sediments used polychaete worms, clams and flatfish as test animals (O.D.C.A.R.F. no.'s 7.2.2 and 8.2.2). Results of these studies cannot be considered conclusive because of various problems encountered due to the nature of the site and study design.

Other related research has looked at the release and bioavailability of contaminants from potential dredge site sediments (O.D.C.A.R.F. no.'s 6.2.1 and 11.2.1). False Creek sediments were also used in a study to develop an easy and inexpensive shipboard bioassay technique using micro-organisms (O.D.C.A.R.F. no. 9.2.5). These objectives were not met with any of the micro-organisms tested. A research study will be started in 1987 to investigate sediment transport and contaminant dispersal pathways at the dump site (O.D.C.A.R.F. no. 13.2.1).

#### **MONITORING INFORMATION:**

The results of monitoring studies conducted at the dump site since 1975 have been reviewed in two recent reports: Brothers et al, 1985 and O.D.C.A.R.F. no. 11.2.2. These studies include bioaccumulation, benthic infauna, physical sediment characteristics, and sediment chemistry. From data generated since 1975, no distinct trends in bioaccumulation of metals can be identified. Elemental metal concentrations in species



captured and analysed fell within the expected range based on concentrations previously identified for the coast of British Columbia.

Differing biological provinces identified by Packman (1980) within the sampling grid and particularly in the north-east quadrant are assumed to be caused by increased dumping in that quadrant. This is not unexpected, as this quadrant lies between the geometric centre of the dump site, and Vancouver Harbour from which a large percentage of the spoils originate. This assumption was also supported by a significant increase in the proportion of the coarse particle fraction in benthic sediments from the same quadrant between 1975 and 1978 (Packman, 1980) and by Pisces dives in 1976, 1978, (Holman, 1983) and 1983 (Brothers, et al., 1985). Evidence of dumping obtained from submersible observations increased from the south west boundary of the site towards Vancouver Harbour.

Chemical analyses of benthic sediments since 1975 also showed no definite trends in metal concentrations. Occasional elevated concentrations of cadmium and lead are reported, but were not corroborated by data from subsequent surveys. Data anomalies such as these may be due to heterogeneity of sediments at the dump site, changes in analytical procedures, contamination of samples after or during collection, or a combination of these variables.

According to Cross, (O.D.C.A.R.F. no. 11.2.2) inconsistencies in stations sampled per study, differences in analytical procedures, and inadequate replication make statistical analysis, and hence trend analysis, inconclusive. It was recommended that a well defined monitoring program be instituted and rigorously followed to ensure that future evaluation procedures can produce meaningful interpretation of environmental conditions at the dump site.



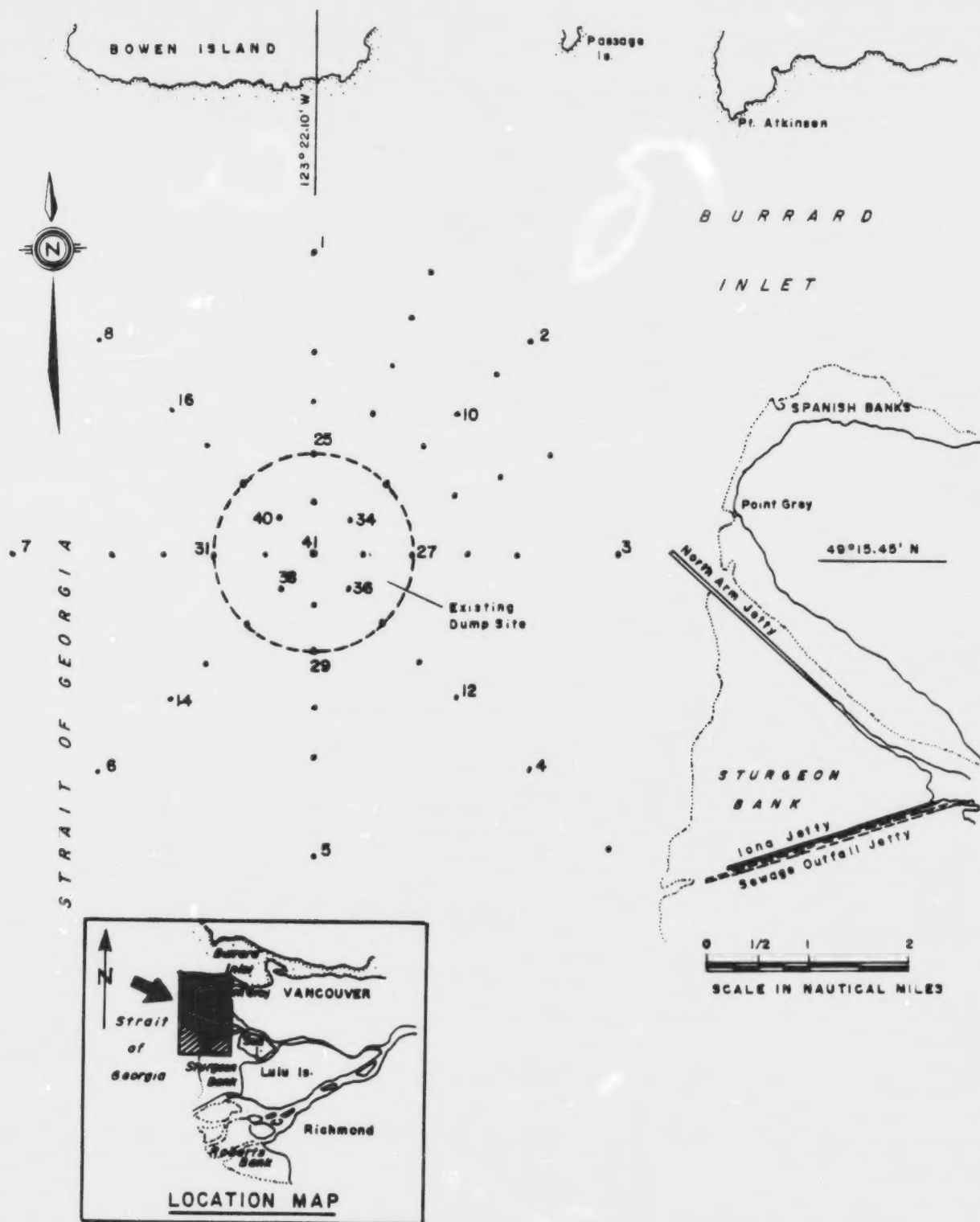


FIGURE 8 POINT GREY OCEAN DUMPSITE - BENTHIC  
SEDIMENT SAMPLING STATIONS

**TABLE 1** POINT GREY OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\* IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION STANDARD DEVIATION - GRAB SAMPLES - APRIL 1986

| STATION | Hg                         | Cd                         | Pb                    | Cu                         | Zn                     |
|---------|----------------------------|----------------------------|-----------------------|----------------------------|------------------------|
| 1       | 0.15                       | 0.32                       | 26                    | 51.9                       | 103                    |
|         | 0.17                       | 0.34                       | 25                    | 51.2                       | 99                     |
|         | 0.18                       | 0.31                       | 29                    | 55.5                       | 107                    |
|         | $\overline{0.17} \pm 0.02$ | $\overline{0.32} \pm 0.02$ | $\overline{27} \pm 2$ | $\overline{52.9} \pm 2.3$  | $\overline{103} \pm 4$ |
| 2       | 0.16                       | 0.30                       | 30                    | 55.6                       | 101                    |
|         | 0.25                       | 0.30                       | 31                    | 60.5                       | 106                    |
|         | 0.15                       | 0.30                       | 31                    | 58.9                       | 107                    |
|         | $\overline{0.19} \pm 0.06$ | $\overline{0.30} \pm 0$    | $\overline{31} \pm 1$ | $\overline{58} \pm 0.5$    | $\overline{105} \pm 3$ |
| 3       | 0.08                       | 0.12                       | 16                    | 26.8                       | 59                     |
|         | 0.08                       | 0.11                       | 14                    | 25.2                       | 54                     |
|         | 0.07                       | 0.11                       | 14                    | 23.0                       | 54                     |
|         | $\overline{0.08} \pm 0.01$ | $\overline{0.11} \pm 0.01$ | $\overline{15} \pm 1$ | $\overline{25.0} \pm 1.9$  | $\overline{56} \pm 3$  |
| 4       | 0.16                       | 0.24                       | 28                    | 58.9                       | 123                    |
|         | 0.17                       | 0.25                       | 22                    | 51.7                       | 117                    |
|         | 0.17                       | 0.24                       | 27                    | 55.4                       | 121                    |
|         | $\overline{0.17} \pm 0.01$ | $\overline{0.24} \pm 0.01$ | $\overline{26} \pm 3$ | $\overline{55.3} \pm 3.6$  | $\overline{120} \pm 3$ |
| 5       | 0.18                       | 0.44                       | 28                    | 50.8                       | 118                    |
|         | 0.19                       | 0.31                       | 25                    | 48.9                       | 114                    |
|         | 0.21                       | 0.21                       | 23                    | 49.5                       | 114                    |
|         | $\overline{0.19} \pm 0.02$ | $\overline{0.32} \pm 0.12$ | $\overline{25} \pm 3$ | $\overline{49.7} \pm 1.0$  | $\overline{115} \pm 2$ |
| 6       | 0.18                       | 0.21                       | 25                    | 48.3                       | 117                    |
|         | 0.21                       | 0.22                       | 22                    | 47.4                       | 116                    |
|         | 0.21                       | 0.23                       | 26                    | 50.3                       | 119                    |
|         | $\overline{0.20} \pm 0.01$ | $\overline{0.22} \pm 0.01$ | $\overline{24} \pm 2$ | $\overline{48.7} \pm 1.5$  | $\overline{117} \pm 2$ |
| 7       | 0.19                       | 0.18                       | 32                    | 54.2                       | 123                    |
|         | 0.19                       | 0.19                       | 24                    | 51.3                       | 120                    |
|         | 0.18                       | 0.19                       | 28                    | 52.6                       | 120                    |
|         | $\overline{0.19} \pm 0.01$ | $\overline{0.19} \pm 0.01$ | $\overline{28} \pm 4$ | $\overline{52.7} \pm 1.5$  | $\overline{121} \pm 2$ |
| 8       | 0.22                       | 0.30                       | 30                    | 57.2                       | 112                    |
|         | 0.23                       | 0.28                       | 32                    | 57.0                       | 112                    |
|         | 0.20                       | 0.29                       | 32                    | 58.1                       | 114                    |
|         | $\overline{0.22} \pm 0.02$ | $\overline{0.29} \pm 0.01$ | $\overline{31} \pm 1$ | $\overline{57.4} \pm 0.06$ | $\overline{113} \pm 2$ |

\* All results expressed in ug/g dry weight

TABLE 1 (Continued)

| STATION | Hg                         | Cd                         | Pb                    | Cu                        | Zn                     |
|---------|----------------------------|----------------------------|-----------------------|---------------------------|------------------------|
| 10      | 0.13                       | 0.30                       | 26                    | 43.7                      | 88                     |
|         | 0.13                       | 0.32                       | 21                    | 45.0                      | 95                     |
|         | 0.10                       | 0.19                       | 18                    | 32.5                      | 64                     |
|         | $\overline{0.12} \pm 0.02$ | $\overline{0.27} \pm 0.07$ | $\overline{22} \pm 4$ | $\overline{40.4} \pm 6.9$ | $\overline{82} \pm 16$ |
| 12      | 0.18                       | 0.26                       | 18                    | 39.4                      | 88                     |
|         | 0.15                       | 0.27                       | 18                    | 38.5                      | 86                     |
|         | 0.16                       | 0.27                       | 20                    | 45.3                      | 100                    |
|         | $\overline{0.16} \pm 0.02$ | $\overline{0.27} \pm 0.01$ | $\overline{19} \pm 1$ | $\overline{41.1} \pm 3.7$ | $\overline{91} \pm 8$  |
| 14      | 0.24                       | 0.21                       | 25                    | 52.0                      | 119                    |
|         | 0.25                       | 0.22                       | 27                    | 50.3                      | 116                    |
|         | 0.20                       | 0.20                       | 28                    | 51.5                      | 119                    |
|         | $\overline{0.23} \pm 0.03$ | $\overline{0.21} \pm 0.01$ | $\overline{27} \pm 2$ | $\overline{51.3} \pm 0.9$ | $\overline{118} \pm 2$ |
| 16      | 0.19                       | 0.29                       | 28                    | 51.9                      | 105                    |
|         | 0.21                       | 0.27                       | 30                    | 52.6                      | 105                    |
|         | 0.19                       | 0.29                       | 30                    | 52.5                      | 104                    |
|         | $\overline{0.20} \pm 0.01$ | $\overline{0.28} \pm 0.01$ | $\overline{29} \pm 1$ | $\overline{52.3} \pm 0.4$ | $\overline{105} \pm 1$ |
| 25      | 0.15                       | 0.32                       | 29                    | 44.1                      | 99                     |
|         | 0.13                       | 0.36                       | 25                    | 39.4                      | 101                    |
|         | 0.17                       | 0.35                       | 22                    | 35.5                      | 83                     |
|         | $\overline{0.15} \pm 0.02$ | $\overline{0.34} \pm 0.02$ | $\overline{25} \pm 4$ | $\overline{40.0} \pm 4.3$ | $\overline{94} \pm 10$ |
| 27      | 0.19                       | 0.26                       | 22                    | 41.5                      | 93                     |
|         | 0.18                       | 0.26                       | 19                    | 41.2                      | 95                     |
|         | 0.22                       | 0.45                       | 24                    | 43.7                      | 95                     |
|         | $\overline{0.20} \pm 0.02$ | $\overline{0.32} \pm 0.01$ | $\overline{22} \pm 3$ | $\overline{42.1} \pm 1.4$ | $\overline{94} \pm 1$  |
| 29      | 0.17                       | 0.27                       | 21                    | 39.9                      | 93                     |
|         | 0.21                       | 0.27                       | 21                    | 38.9                      | 87                     |
|         | 0.16                       | 0.30                       | 23                    | 40.2                      | 90                     |
|         | $\overline{0.18} \pm 0.03$ | $\overline{0.28} \pm 0.02$ | $\overline{22} \pm 1$ | $\overline{40.0} \pm 0.7$ | $\overline{90} \pm 3$  |
| 31      | 0.14                       | 0.28                       | 26                    | 43.3                      | 94                     |
|         | 0.13                       | 0.30                       | 28                    | 44.2                      | 93                     |
|         | 0.13                       | 0.32                       | 27                    | 42.2                      | 94                     |
|         | $\overline{0.13} \pm 0.01$ | $\overline{0.30} \pm 0.02$ | $\overline{27} \pm 1$ | $\overline{43.2} \pm 1.0$ | $\overline{95} \pm 2$  |

\* All results expressed in ug/g dry weight

TABLE 1 (Continued)

| STATION   | Hg              | Cd              | Pb             | Cu              | Zn            |
|-----------|-----------------|-----------------|----------------|-----------------|---------------|
| 34        | 0.10            | 0.20            | 17             | 28.5            | 72.8          |
|           | 0.14            | 0.24            | 18             | 32.2            | 97.0          |
|           | 0.11            | 0.31            | 14             | 32.3            | 87.1          |
|           | $0.12 \pm 0.02$ | $0.25 \pm 0.06$ | $16 \pm 2$     | $31.0 \pm 2.2$  | $85.6 \pm 12$ |
|           |                 |                 |                |                 |               |
| 36        | 0.15            | 0.29            | 29             | 164.0           | 103           |
|           | 0.16            | 0.30            | 34             | 37.8            | 86            |
|           | 0.19            | 0.27            | 42             | 38.0            | 89            |
|           | $0.17 \pm 0.02$ | $0.29 \pm 0.02$ | $35 \pm 7$     | $79.9 \pm 72.8$ | $92 \pm 10$   |
|           |                 |                 |                |                 |               |
| 38        | 0.13            | 0.31            | 24             | 36.8            | 87            |
|           | 0.19            | 0.24            | 25             | 37.4            | 88            |
|           | 0.22            | 0.27            | 38             | 39.7            | 125           |
|           | $0.18 \pm 0.05$ | $0.27 \pm 0.04$ | $29 \pm 8$     | $38.0 \pm 1.5$  | $100 \pm 22$  |
|           |                 |                 |                |                 |               |
| 40        | 0.11            | 0.22            | 22             | 32.6            | 80            |
|           | 0.15            | 0.23            | 23             | 32.4            | 77            |
|           | 0.10            | 0.23            | 19             | 31.1            | 82            |
|           | $0.12 \pm 0.03$ | $0.23 \pm 0.01$ | $21 \pm 2$     | $32.0 \pm 0.8$  | $80 \pm 3$    |
|           |                 |                 |                |                 |               |
| 41        | 0.30            | 0.27            | 20             | 35.1            | 103           |
|           | 0.22            | 0.63            | 15             | 35.0            | 88            |
|           | 0.14            | 0.23            | 19             | 29.0            | 101           |
|           | $0.22 \pm 0.08$ | $0.38 \pm 0.22$ | $18 \pm 3$     | $33.0 \pm 3.5$  | $97 \pm 8$    |
|           |                 |                 |                |                 |               |
| MESS-1    |                 |                 |                |                 |               |
| Certified | $0.17 \pm 0.01$ | $0.59 \pm 0.10$ | $34.0 \pm 6.1$ | $25.1 \pm 3.8$  | $191 \pm 17$  |
| Found     | 0.21            | 0.45            | 31             | 23.7            | 176           |
|           | 0.18            | 0.46            | 29             | 22.7            | 156           |
|           | 0.19            | 0.46            | 30             | 21.9            | 157           |
|           | 0.20            | 0.55            | 31             | 22.4            | 175           |
|           | 0.18            | 0.47            | 30             | 22.6            | 169           |
| BCSS-1    |                 |                 |                |                 |               |
| Certified | $0.13 \pm 0.01$ | $0.25 \pm 0.04$ | $22.7 \pm 3.4$ | $18.5 \pm 2.7$  | $119 \pm 12$  |
| Found     | 0.15            | 0.29            | 25             | 16.5            | 101           |
|           | 0.13            | 0.33            | 28             | 16.5            | 103           |
|           | 0.14            | 0.30            | 24             | 14.9            | 97            |
|           | 0.13            | 0.30            | 25             | 15.7            | 100           |
|           | 0.15            | 0.39            | 27             | 14.5            | 95            |

\* All results expressed in ug/g dry weight

DUMPSITE: PWC SPOIL AREAS 8 and 8A  
NUMBER: 8  
CO-ORDINATES: 49°15.70'N 123°17.30'W 49°16.40'N 123°16.70'N  
DEPTH: not less than 18 metres not less than 5 metres  
TOTAL QUANTITY  
DUMPED: 1 520 136 cubic metres  
COMMENTS:

Spoil Area 8A designated as a foul weather alternative.

**LOADSITE INFORMATION:**

Public Works Canada (P.W.C.) have exclusive use of Spoil Areas 8 and 8A at the mouth of the Fraser River North Arm. Channel maintenance projects in the Main Arm and North Arm of the river are carried out by the P.W.C. suction hopper dredge no. 312 'Fort Langley.' The Fort Langley generally releases 50,000 to 200,000 cubic metres of clean river silt and sand at these sites annually. The Department of Fisheries and Oceans require P.W.C. to conduct any suction dredging activities in compliance with the Fraser River Dredging Guidelines.

**RESEARCH INFORMATION:**

No research information available.

|                       |                          |
|-----------------------|--------------------------|
| <b>DUMPSITE:</b>      | <u><b>SAND HEADS</b></u> |
| <b>NUMBER:</b>        | 9                        |
| <b>CO-ORDINATES:</b>  | 49°06.00'N 123°19.50'W   |
| <b>DEPTH:</b>         | 70 metres                |
| <b>TOTAL QUANTITY</b> |                          |
| <b>DUMPED:</b>        | 2 190 966 cubic metres   |
| <b>COMMENTS:</b>      |                          |

Dumpsite used since 1974 mainly by PWC for Fraser River channel maintenance.

#### **LOADSITE INFORMATION:**

The Sandheads dumpsite receives only clean silt, sand or gravel from channel maintenance or infill type dredging operations on the Fraser River. Material originating from industrial sites and which may contain woodwastes or other contaminants is not approved for disposal at this site. Due to the requirement for clean, non-organic spoils, there is not a large volume of material dumped at this site; however, sloughing undoubtedly occurs from the nearby Public Works Canada Spoil area 1 (see dumpsite no. 9A). The Department of Fisheries and Oceans general timing guidelines for clamshell dredging apply. Clamshell dredging is subject to a site-specific review during the period March 1 to August 1 to avoid interference with eulachon and juvenile salmonid utilization of the river.

#### **RESEARCH INFORMATION:**

No research information available.

#### **MONITORING INFORMATION:**

A preliminary core survey was conducted at the dumpsite in July 1980 (Figure 9). Trace metal concentrations were of no concern and undoubtedly heavily influenced by Fraser River sediments (Table 2). Further benthic sediment surveys are planned for 1987.

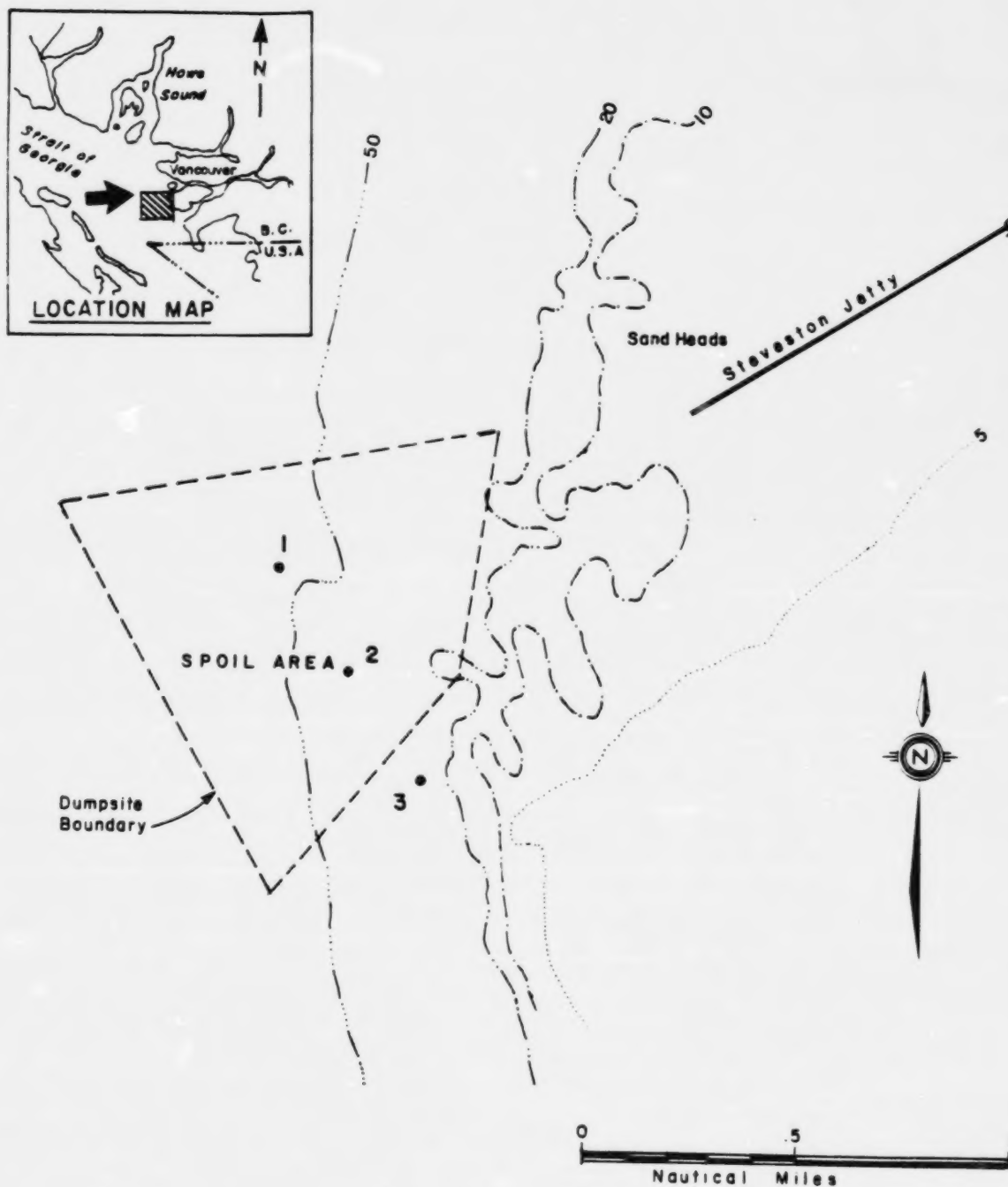


FIGURE 9 SAND HEADS OCEAN DUMPSITE - BENTHIC  
SEDIMENT SAMPLING STATIONS



**TABLE 2**     **SAND HEADS OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\***  
**IN BENTHIC SEDIMENTS - CORE SAMPLES - JULY 1980**

| STATION  | Hg           | Cd        | Pb   | Cu   | Zn   |
|----------|--------------|-----------|------|------|------|
| 1        |              |           |      |      |      |
| 0-10 cm  | 0.126        | N.D.(.55) | 41.8 | 37.3 | 80.5 |
| 30-40 cm | N.D.(.130)** | N.D.(.54) | 44.3 | 41.5 | 84.0 |
| 60-70 cm | N.D.(.133)   | N.D.(.55) | 42.6 | 37.3 | 80.0 |
| 2        |              |           |      |      |      |
| 0-10 cm  | N.D.(.121)   | N.D.(.55) | 38.1 | 31.3 | 68.0 |
| 30-40 cm | N.D.(.133)   | N.D.(.56) | 35.7 | 29.6 | 66.0 |
| 3        |              |           |      |      |      |
| 0-10 cm  | N.D.(.135)   | N.D.(.55) | 31.1 | 29.2 | 69.5 |
| 30-40 cm | 0.120        | N.D.(.56) | 33.3 | 32.2 | 73.5 |
| 60-70 cm | N.D.(.132)   | N.D.(.55) | 28.4 | 30.8 | 65.5 |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

DUMPSITE: SAND HEADS PWC SPOIL AREA 1  
NUMBER: 9A  
CO-ORDINATES: 49°06.10'N 123°18.30'W  
DEPTH: not less than 27 metres  
TOTAL QUANTITY  
DUMPED: 2 661 759 cubic metres  
LOADSITE INFORMATION:

Public Works Canada (P.W.C.) have exclusive use of their Sandheads Spoil Area 1. The dumpsite is just east (ie: outside) of the boundary delineating the Sandheads Spoil Area on Hydrographic charts (see dumpsite no. 9). The site was moved closer to the entrance of the South Arm several years ago to enable the P.W.C. suction hopper dredge no. 312 'Fort Langley' to operate closer to the dredging areas. Annual disposal at the site by th Fort Langley is approximately 500 000 to 1 000 000 cubic metres of clean river silt and sand usually originating from the South Arm, Fraser River. The Department of Fisheries and Oceans Fraser River Dredging Guidelines must be adhered to.

RESEARCH INFORMATION:

No research information available.

DUMPSITE: VICTORIA  
NUMBER: 14  
CO-ORDINATES: 48°22.30'N 123°21.80'W  
DEPTH: 90 metres  
TOTAL QUANTITY  
DUMPED: 264 424 cubic metres  
COMMENTS:

Previously known as Quarantine Buoy. Site designated by Ministry of Transportation in 1970.

**LOAD SITE INFORMATION:**

Most of the material dumped at the Victoria dumpsite originates in Victoria Harbour and Selkirk Water. Fisheries and Oceans generally prohibit dredging/loading in Victoria Harbour during the period February 15 to April 15 to protect adult and juvenile herring stocks. Dumping is prohibited from August 1 to September 15 to protect migrating sockeye salmon.

The British Columbia Forest Products sawmill in the Selkirk Waters conducts periodic maintenance dredging of bark and wood debris and disposes of the spoils at the dumpsite. Surface sediments in the inner harbour of Victoria were found to be contaminated with cadmium and mercury during a harbour re-development project in 1977 and during maintenance dredging at Ships Point wharf in 1983. In 1985, samples collected in the Laurel Point area, historically occupied by a Babco Paints plant, were found to contain extremely high levels of contaminants. The contaminants included: cadmium up to 45 ug/g; mercury up to 84 ug/g; lead up to 3% and polychlorinated biphenyls in excess of 850 ug/g. The application to dredge in this area was rejected and the contaminated sediments were placed in barrels and removed to a landfill site.

In 1985, a proponent wishing to dredge in the Shoal Point area was required to load contaminated surface sediments onto a barge and hold them on site while 'over dredging' the area. The held spoils containing elevated levels of polychlorinated biphenyls and oil and grease were subsequently deposited in the depression created and capped with clean sediments. The excess clean dredged material was disposed at the dumpsite.

Applications to dump dredge spoils from Esquimalt harbour are usually rejected on the basis of chemical contamination. This was recently the case (ie: December 1986) when levels of cadmium ( approximately 7 ug/g) and lead (approximately 6,000 ug/g) exceeded O.D.C.A. guideline limits.

#### RESEARCH INFORMATION:

In conjunction with the harbour re-development project in 1977, a research study (O.D.C.A.R.F. 3.2.4) demonstrated the variability in analytical results between sediment samples collected prior to commencement of dredging and from the scows during dredging. The differences were significant although not large.

The effects of dumping contaminated sediments in an area near commercial fishing grounds, such as near the Victoria dumpsite, were evaluated in a study (O.D.C.A.R.F. 6.2.3, 7.2.4) involving the eggs and larvae of Pacific cod. The results suggested that a very thin layer of contaminated sediment over fertilized eggs could reduce larval hatch and that time to hatching increased with increasing depth of uncontaminated sediments. Two-follow up studies (O.D.C.A.R.F. 12.2.1 and 12.2.4) involving the eggs of four commercial fish species are currently underway.

#### MONITORING INFORMATION:

Monitoring studies have been conducted at the Victoria dump site (Figure 10) in November 1982 and in April 1986 (Tables 3 and 4).

Because of the strong tidal currents, the benthic sediments at this dump site are comprised of fine and coarse sands, shell fragments, with

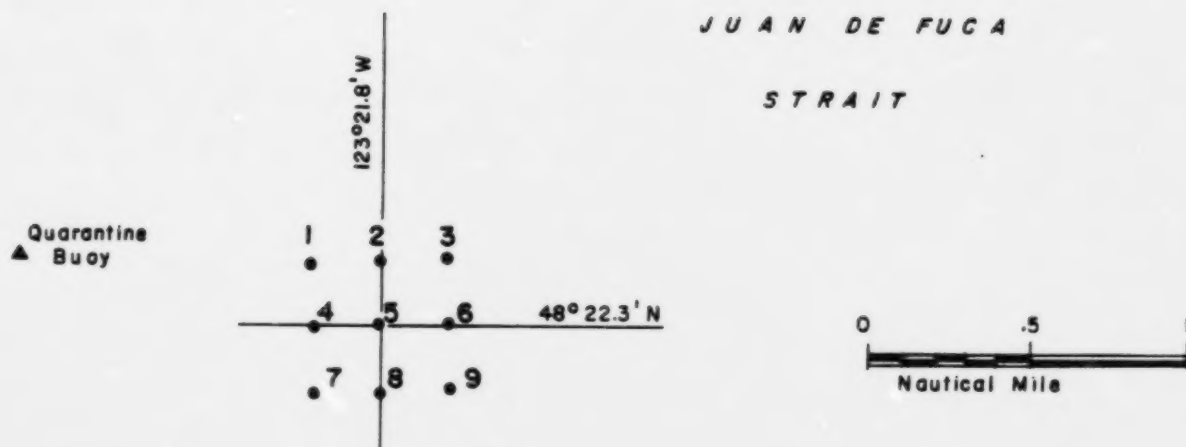


FIGURE 10 VICTORIA OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

very little silt or fine sediments. Data generated from the surveys show trace metal concentrations lower than those identified for the Strait of Georgia. Pisces IV dives were completed at the dump site in May, 1979. No dive records are available.

**TABLE 3** VICTORIA OCEAN DUMP SITE- TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - GRAB SAMPLES - NOVEMBER 1982

| STATION | Hg                  | Cd         | Pb      | Cu   | Zn   |
|---------|---------------------|------------|---------|------|------|
| 1       | 0.05                | N.D.(.3)** | 133     | 18.6 | 48.0 |
| 2       | .....NO SAMPLE..... |            |         |      |      |
| 3       | 0.05                | N.D.(.3)   | N.D.(3) | 12.0 | 47.1 |
| 4       | .....NO SAMPLE..... |            |         |      |      |
| 5       | 0.06                | N.D.(.3)   | 9       | 29.4 | 63.0 |
| 6       | 0.06                | N.D.(.3)   | 4       | 18.3 | 57.7 |
| 7       | 0.05                | N.D.(.3)   | N.D.(3) | 33.2 | 47.2 |
| 8       | 0.09                | N.D.(.3)   | N.D.(3) | 54.4 | 79.9 |
| 9       | 0.05                | N.D.(.3)   | N.D.(3) | 25.3 | 36.5 |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection



**TABLE 4** VICTORIA OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\* IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION STANDARD DEVIATION - GRAB SAMPLES - APRIL 1986

| STATION | Hg              | Cd              | Pb          | Cu              | Zn          |
|---------|-----------------|-----------------|-------------|-----------------|-------------|
| 1       | 0.06            | 0.09            | 9           | 14.0            | 48          |
|         | 0.07            | 0.12            | 9           | 14.5            | 50          |
|         | 0.04            | 0.10            | 14          | 14.5            | 48          |
|         | $0.06 \pm 0.02$ | $0.10 \pm 0.02$ | $11 \pm 3$  | $14.3 \pm 0.3$  | $49 \pm 1$  |
| 2       | 0.05            | 0.13            | 11          | 17.1            | 44          |
|         | 0.05            | 0.20            | 94          | 18.7            | 52          |
|         | 0.04            | 0.13            | 12          | 15.9            | 44          |
|         | $0.05 \pm 0.01$ | $0.15 \pm 0.04$ | $39 \pm 48$ | $17.2 \pm 1.4$  | $47 \pm 5$  |
| 3       | 0.04            | 0.17            | 10          | 17.6            | 46          |
|         | 0.04            | 0.23            | 7           | 14.7            | 39          |
|         | 0.05            | 0.12            | 9           | 13.9            | 41          |
|         | $0.04 \pm 0.01$ | $0.17 \pm 0.06$ | $9 \pm 2$   | $15.4 \pm 2.0$  | $42 \pm 4$  |
| 4       | 0.08            | 0.09            | 15          | 22.2            | 50          |
|         | 0.08            | 0.14            | 15          | 21.3            | 52          |
|         | 0.12            | 0.12            | 26          | 23.2            | 52          |
|         | $0.09 \pm 0.02$ | $0.12 \pm 0.03$ | $19 \pm 6$  | $22.2 \pm 1.0$  | $51 \pm 1$  |
| 5       | 0.03            | 0.17            | 73          | 18.6            | 57          |
|         | 0.03            | 0.14            | 10          | 13.2            | 38          |
|         | 0.05            | 0.11            | 16          | 12.8            | 41          |
|         | $0.04 \pm 0.01$ | $0.14 \pm 0.03$ | $33 \pm 35$ | $14.9 \pm 3.2$  | $45 \pm 10$ |
| 6       | 0.13            | 0.10            | 7           | 11.5            | 36          |
|         | 0.03            | 0.09            | 8           | 11.2            | 35          |
|         | 0.01            | 0.10            | 9           | 11.3            | 32          |
|         | $0.06 \pm 0.06$ | $0.10 \pm 0.01$ | $8 \pm 1$   | $11.3 \pm 0.02$ | $34 \pm 2$  |
| 7       | 0.06            | 0.11            | 9           | 9.9             | 35          |
|         | 0.05            | 0.15            | 20          | 10.2            | 32          |
|         | 0.04            | 0.25            | 4           | 9.8             | 30          |
|         | $0.05 \pm 0.01$ | $0.17 \pm 0.07$ | $11 \pm 8$  | $10.0 \pm 0.2$  | $32 \pm 3$  |
| 8       | 0.06            | 0.12            | 9           | 13.6            | 36          |
|         | 0.05            | 0.14            | 8           | 10.6            | 35          |
|         | 0.04            | 0.09            | 5           | 10.5            | 35          |
|         | $0.05 \pm 0.01$ | $0.12 \pm 0.03$ | $7 \pm 2$   | $11.6 \pm 1.8$  | $35 \pm 1$  |

\* All results expressed in ug/g dry weight

TABLE 4 (Continued)

| STATION | Hg           | Cd              | Pb        | Cu             | Zn           |
|---------|--------------|-----------------|-----------|----------------|--------------|
| 9       | 0.05         | 0.10            | 8         | 10.6           | 37           |
|         | 0.05         | 0.11            | 9         | 10.5           | 39           |
|         | 0.05         | 0.13            | 5         | 9.7            | 36           |
|         | $0.05 \pm 0$ | $0.11 \pm 0.02$ | $7 \pm 2$ | $10.3 \pm 0.5$ | $37 \pm 1.5$ |

MESS - 1

|           |                 |                 |                |                |              |
|-----------|-----------------|-----------------|----------------|----------------|--------------|
| Certified | $0.17 \pm 0.01$ | $0.59 \pm 0.10$ | $34.0 \pm 6.1$ | $25.1 \pm 3.8$ | $191 \pm 17$ |
| Found     | 0.21            | 0.59            | 34             | 23.8           | 166          |
|           | 0.20            | 0.71            | 34             | 23.1           | 172          |
|           | 0.23            | 0.61            | 33             | 23.8           | 173          |
|           | 0.22            | 0.67            | 39             | 24.7           | 176          |
|           | 0.24            | 0.60            | 36             | 24.1           | 176          |

BCSS - 1

|           |                 |                 |                |                |              |
|-----------|-----------------|-----------------|----------------|----------------|--------------|
| Certified | $0.13 \pm 0.01$ | $0.25 \pm 0.04$ | $22.7 \pm 3.4$ | $18.5 \pm 2.7$ | $119 \pm 12$ |
| Found     | 0.14            | 0.36            | 29             | 17.3           | 111          |
|           | 0.15            | 0.41            | 31             | 17.2           | 113          |
|           | 0.15            | 0.40            | 25             | 16.6           | 110          |
|           | 0.16            | 0.39            | 27             | 15.4           | 104          |
|           | 0.15            | 0.37            | 26             | 14.8           | 102          |

\* All results expressed in ug/g dry weight

DUMPSITE: HARO STRAIT  
NUMBER: 18  
CO-ORDINATES: 48°41.00'N 123°16.40'W  
DEPTH: 200 metres  
TOTAL QUANTITY  
DUMPED: 112 148 cubic metres  
LOADSITE INFORMATION:

The Haro Strait dumpsite was originally designated for disposal of dredge spoils from the loading dock at Inland Cement Industries Ltd. cement plant at Bamberton in Saanich Inlet. In 1977 about 4 000 cubic metres of marine sediment mixed with gypsum, cement and iron ore (spillage from loading operations) were dumped. In 1979, another 2 000 cubic metres of similar material was dumped; however, there have been no subsequent applications received for the Bamberton site. In the spring of 1985, Public Works Canada (O.D.C.A. file no. -01537) dredged and dumped approximately 16 000 cubic metres of silt and sand from Tsehum Harbour just north of Sidney, B.C. Chemical analysis of samples from this marina expansion project did not indicate a contamination problem. Two other proposed projects involving the Haro Strait dumpsite, i.e.; expansion of the Island View Marina in Sidney and maintenance of a seaplane base at Patricia Bay in Saanich Inlet, have been put on hold indefinitely by the proponents.

The Department of Fisheries and Oceans requests that dredging and dumping activities be scheduled during the period October 1 to June 1 to avoid conflict with juvenile and adult salmon. The British Columbia Ministry of Environment recommends that proponents contact the Capital Regional District Engineering Department to determine the suitability and practicability of disposing of dredged sediments at the Hartland Road Landfill as cover material.

**MONITORING INFORMATION:**

A benthic sediment survey was conducted in November 1982 (Figure 11).

Trace metal concentrations are extremely low at this site as compared with concentrations identified for the Strait of Georgia (Table 5). This is assumed to be the result of strong currents in the area removing the finer sediment fraction. Field notes show that benthic sediments were composed primarily of sand and cobble (C & P, on file).

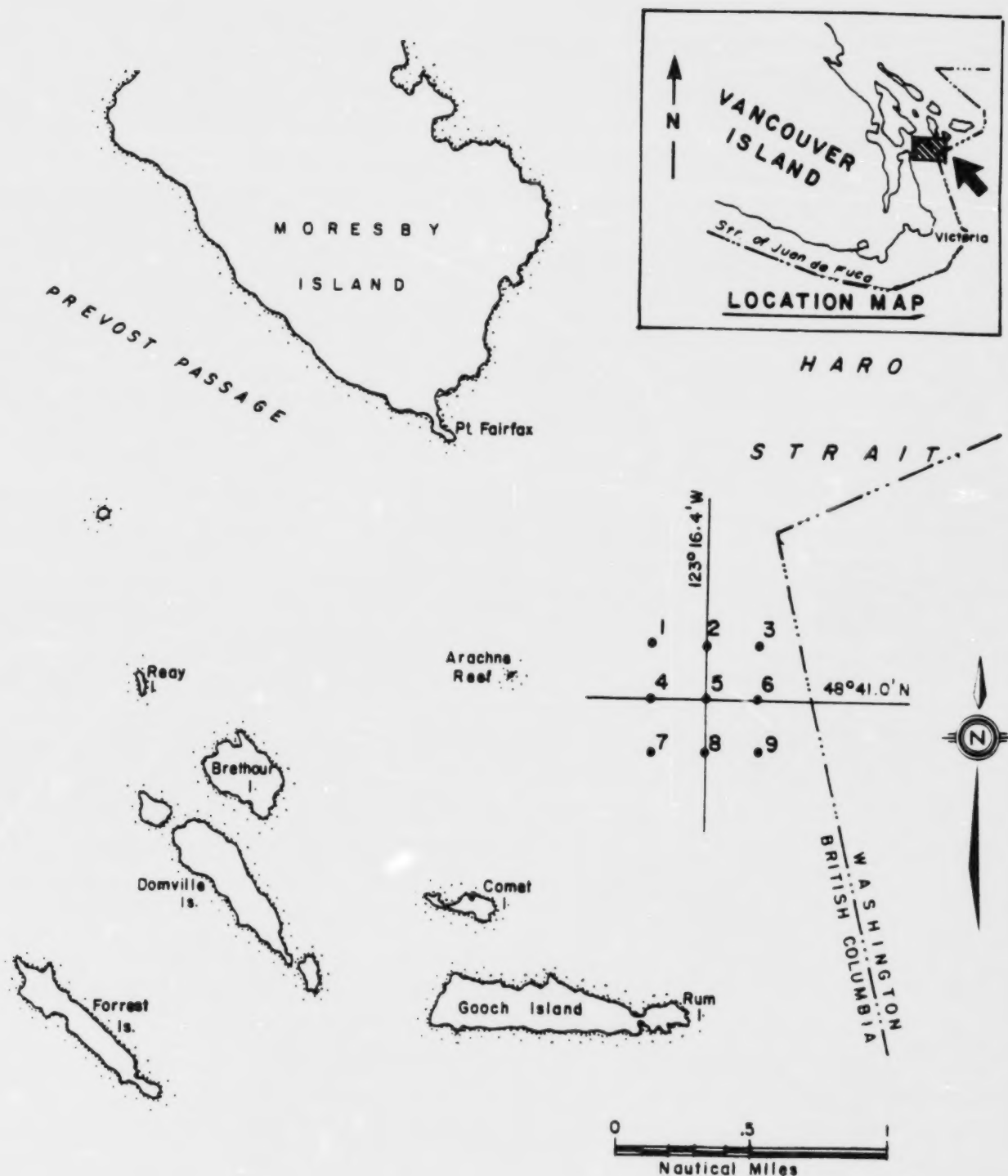


FIGURE 11 HARO STRAIT OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

**TABLE 5** HARO STRAIT OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - GRAB SAMPLES - NOVEMBER 1982

| STATION | Hg   | Cd         | Pb      | Cu   | Zn   |
|---------|------|------------|---------|------|------|
| 1       | 0.08 | N.D.(.3)** | 6       | 16.8 | 62.5 |
| 2       | 0.06 | N.D.(.3)   | N.D.(3) | 13.3 | 48.4 |
| 3       | 0.07 | N.D.(.3)   | N.D.(3) | 11.1 | 40.1 |
| 4       | 0.08 | N.D.(.3)   | N.D.(3) | 12.1 | 49.6 |
| 5       | 0.07 | N.D.(.3)   | N.D.(3) | 11.9 | 45.5 |
| 6       | 0.05 | N.D.(.3)   | N.D.(3) | 9.9  | 34.5 |
| 7       | 0.10 | N.D.(.3)   | N.D.(3) | 15.3 | 56.0 |
| 8       | 0.13 | N.D.(.3)   | N.D.(3) | 9.6  | 39.6 |
| 9       | 0.08 | N.D.(.3)   | N.D.(3) | 13.8 | 43.9 |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

DUMPSITE: PORLIER PASS  
NUMBER: 32  
CO-ORDINATES: 49°00.20'N 123°29.80'W  
DEPTH: 200 metres  
TOTAL QUANTITY  
DUMPED: 83 200 cubic metres  
LOADSITE INFORMATION:

The majority of material dumped at the Porlier Pass site has originated from the British Columbia Forest Products (B.C.F.P.) pulp mill at Crofton. Marine sediments with a large proportion of woodwastes have been dredged from the B.C.F.P. scow loading dock, woodroom area and deep sea dock for many years. Prior to 1976, dredge spoils had been dumped in Stuart Channel; however, with the designation of the Porlier Pass dumpsite, this area, which supports commercial and recreational fisheries, was no longer used. The dumpsite was first used in 1978 (O.D.C.A. file no. -00585) to dispose of about 32,000 cubic metres of dredge spoil. In 1979, approximately 24,000 cubic metres of spoils containing about 60% woodwaste were dumped.

In 1981, about 18,000 cubic metres of compact clay from a dock expansion project were dumped. Under B.C.F.P.'s current Approval (O.D.C.A. file no. -02099) approximately 2,500 cubic metres of material was dredged from the chip scow dock and woodroom.

Concern expressed over the years by the Department of Fisheries and Oceans has resulted in a larger portion of woodwastes being segregated and taken to landfill rather than ocean disposal. Since there is a large amount of organic material around the pulp mill, the potential for release of toxic hydrogen sulphide gas exists during dredging operations. Care is taken to ensure that no fish are in the area during these operations. Dredging/loading and ocean dumping activities are generally restricted to the period August 1 to January 31 to protect rearing and migrating salmon and herring, and spawning and rearing groundfish.



Sediments from the Crofton pulpmill were analysed in 1979 for cadmium, mercury, copper and zinc, and in 1982 for these metals plus polychlorinated biphenyl. There was no indication of contamination. One slightly elevated level for cadmium was reported prior to dredging in 1982; however, samples taken from the scow during loading were not contaminated. Although the Crofton pulpmill used zinc dithionite as a bleaching agent up until the early 1970's, there do not appear to be elevated levels of zinc and cadmium in the sediments as found at other B.C. groundwood pulpmills which used this process.

The Porlier Pass dump site was used in 1986 for dredge spoils originating from Doman's Ladysmith Forest Products Division in Ladysmith Harbour (O.D.C.A. file no. -02019). The sawmill is located close to an old smelter site and slag is found in sediments throughout the area. Chemical analysis of sediments revealed a surface organic layer slightly contaminated with cadmium (ie: 1-2 ug/g). This surface layer was removed for disposal on land. Deeper sediments containing some of the old slag contained elevated levels of zinc and copper; however, this material was not considered bioavailable and was therefore approved for ocean dumping.

#### RESEARCH INFORMATION:

No research information available.

#### MONITORING INFORMATION:

Benthic sediment surveys were conducted in September 1981 and July 1986 (Figure 12).

The results of these surveys do not indicate any adverse effects from ocean dumping activities (Tables 6 and 7).

Pisces IV dives were conducted in September 1976 and March 1980 (Petrie and Holman, 1983). Dive records from 1976 indicate a variety of substrates in the dump site vicinity and prolific epifaunal and infaunal benthic communities. In 1980, the divers reported similar benthic conditions and no deleterious effects from ocean disposal.

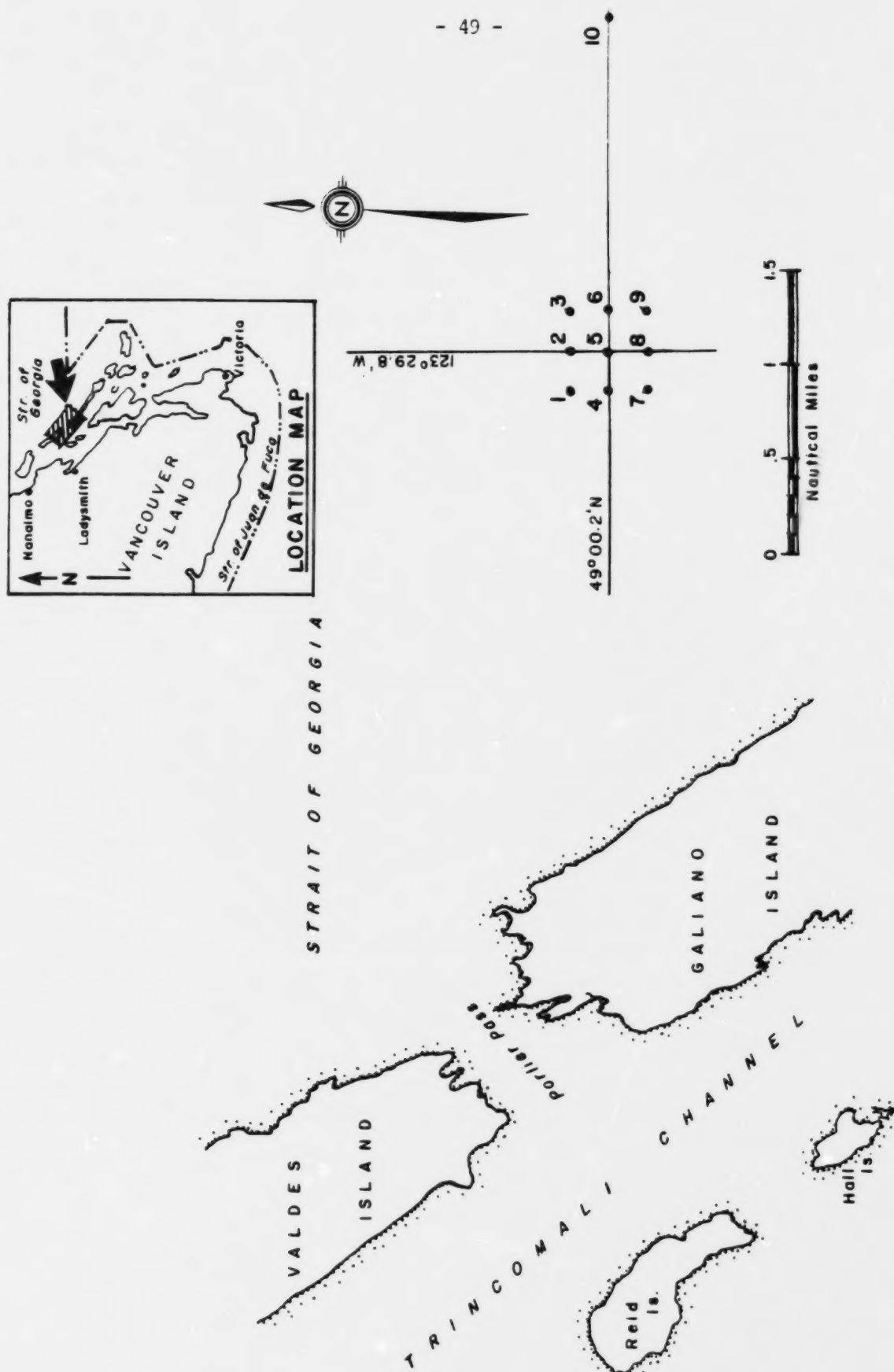


FIGURE 12 PORLIER PASS OCEAN DUMPSITE BENTHIC SEDIMENT SAMPLING STATIONS

**TABLE 6**      **PORLIER PASS OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\***  
**IN BENTHIC SEDIMENTS - GRAB AND CORE SAMPLES - SEPTEMBER 1981**

| STATION    | Hg           | Cd        | Pb   | Cu   | Zn    |
|------------|--------------|-----------|------|------|-------|
| 1          | N.D.(.179)** | N.D.(.58) | 14.5 | 42.5 | 99.0  |
| 2          | N.D.(.179)   | N.D.(.58) | 16.0 | 43.1 | 100.0 |
| 3          | N.D.(.179)   | N.D.(.58) | 15.6 | 38.9 | 91.6  |
| 4          | N.D.(.179)   | N.D.(.58) | 16.4 | 39.7 | 96.9  |
| 5          |              |           |      |      |       |
| 0-5 cm     | 0.173        | N.D.(.58) | 17.5 | 42.3 | 101.0 |
| 10-15 cm   | N.D.(.132)   | N.D.(.58) | 15.6 | 43.8 | 99.9  |
| 20-25 cm   | N.D.(.132)   | N.D.(.58) | 14.5 | 41.5 | 95.0  |
| 60-65 cm   | N.D.(.132)   | N.D.(.58) | 10.2 | 35.6 | 85.3  |
| 175-180 cm | N.D.(.132)   | N.D.(.58) | 11.3 | 35.9 | 85.0  |
| 6          | 0.176        | N.D.(.58) | 16.4 | 39.1 | 95.7  |
| 7          | 0.199        | N.D.(.58) | 15.7 | 40.2 | 97.9  |
| 8          | 0.202        | N.D.(.58) | 17.2 | 42.6 | 104.0 |
| 9          | N.D.(.133)   | N.D.(.58) | 15.4 | 38.9 | 96.1  |

\* All results expressed in ug/g dry weight  
 \*\*Numbers in brackets are limits of detection

**TABLE 7** PORLIER PASS OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB AND CORE SAMPLES - JULY 1986

| STATION         | Hg                                      | Cd                                      | Pb                           | Cu                                         | Zn                                 |
|-----------------|-----------------------------------------|-----------------------------------------|------------------------------|--------------------------------------------|------------------------------------|
| 1               | 0.14<br>0.14<br>0.17<br>$0.15 \pm 0.02$ | 0.35<br>0.33<br>0.56<br>$0.41 \pm 0.13$ | 30<br>31<br>31<br>$31 \pm 1$ | 48.6<br>49.8<br>48.8<br>$49.1 \pm 0.6$     | 122<br>140<br>124<br>$129 \pm 10$  |
| 2               | 0.13<br>0.24<br>0.15<br>$0.17 \pm 0.06$ | 0.39<br>0.34<br>0.41<br>$0.38 \pm 0.04$ | 26<br>21<br>28<br>$25 \pm 4$ | 51.2<br>44.2<br>46.7<br>$47.4 \pm 3.5$     | 165<br>133<br>125<br>$141 \pm 21$  |
| 3               | 0.10<br>0.10<br>0.12<br>$0.11 \pm 0.01$ | 0.42<br>0.41<br>0.99<br>$0.61 \pm 0.33$ | 19<br>24<br>15<br>$19 \pm 5$ | 73.9<br>249.0<br>53.9<br>$125.6 \pm 107.3$ | 173<br>424<br>154<br>$250 \pm 150$ |
| 4               | 0.11<br>0.10<br>0.11<br>$0.11 \pm 0.01$ | 0.42<br>0.42<br>0.70<br>$0.51 \pm 0.16$ | 26<br>32<br>28<br>$29 \pm 3$ | 46.0<br>49.0<br>47.7<br>$47.6 \pm 1.5$     | 125<br>121<br>122<br>$123 \pm 2$   |
| 5               | 0.16<br>0.10<br>0.09<br>$0.12 \pm 0.04$ | 1.26<br>0.60<br>0.83<br>$0.90 \pm 0.34$ | 29<br>22<br>27<br>$26 \pm 4$ | 48.1<br>42.2<br>48.8<br>$46.4 \pm 3.6$     | 125<br>122<br>126<br>$124 \pm 2$   |
| 5<br>(Depth-cm) |                                         |                                         |                              |                                            |                                    |
| 30-40           | 0.09                                    | 1.07                                    | 32                           | 49.1                                       | 125                                |
| 60-70           | 0.08                                    | 0.91                                    | 23                           | 40.4                                       | 110                                |
| 90-100          | 0.08                                    | 0.48                                    | 24                           | 43.1                                       | 111                                |
| 120-130         | 0.08                                    | 0.44                                    | 15                           | 37.5                                       | 109                                |
| 150-160         | 0.07                                    | 0.46                                    | 20                           | 37.0                                       | 108                                |
| 6               | 0.10<br>0.09<br>0.07<br>$0.09 \pm 0.02$ | 0.47<br>0.57<br>0.63<br>$0.56 \pm 0.08$ | 30<br>30<br>31<br>$30 \pm 1$ | 48.0<br>48.1<br>46.9<br>$47.7 \pm 0.7$     | 121<br>118<br>118<br>$119 \pm 2$   |

\* All results expressed as ug/g dry weight

TABLE 7 (Continued)

| STATION   | Hg                                      | Cd                                      | Pb                           | Cu                                     | Zn                               |
|-----------|-----------------------------------------|-----------------------------------------|------------------------------|----------------------------------------|----------------------------------|
| 7         | 0.11<br>0.11<br>0.11<br>$0.11 \pm 0.0$  | 0.41<br>1.54<br>2.90<br>$1.62 \pm 1.25$ | 28<br>31<br>35<br>$31 \pm 4$ | 46.8<br>49.2<br>49.7<br>$48.6 \pm 1.6$ | 125<br>125<br>125<br>$125 \pm 0$ |
| 8         | 0.12<br>0.14<br>0.10<br>$0.12 \pm 0.02$ | 0.38<br>0.43<br>0.55<br>$0.45 \pm 0.09$ | 33<br>33<br>34<br>$33 \pm 1$ | 51.9<br>50.6<br>51.0<br>$51.2 \pm 0.7$ | 125<br>122<br>124<br>$124 \pm 2$ |
| 9         | 0.12<br>0.12<br>0.10<br>$0.11 \pm 0.01$ | 0.60<br>0.52<br>0.56<br>$0.56 \pm 0.04$ | 25<br>33<br>32<br>$30 \pm 4$ | 45.7<br>50.7<br>50.5<br>$49.0 \pm 2.8$ | 121<br>120<br>123<br>$121 \pm 2$ |
| 10        | 0.07<br>0.08<br>0.09<br>$0.08 \pm 0.01$ | 0.51<br>0.68<br>0.58<br>$0.59 \pm 0.09$ | 27<br>30<br>34<br>$30 \pm 4$ | 36.8<br>39.6<br>39.7<br>$38.7 \pm 1.6$ | 118<br>119<br>119<br>$119 \pm 1$ |
| MESS -1   |                                         |                                         |                              |                                        |                                  |
| Certified | $0.17 \pm 0.01$                         | $0.59 \pm 0.10$                         | $34.0 \pm 6.1$               | $25.1 \pm 3.8$                         | $191 \pm 17$                     |
| Found     | 0.25<br>0.22<br>0.24<br>0.25<br>0.25    | 0.55<br>0.64<br>0.64<br>0.66<br>0.70    | 47<br>42<br>41<br>40<br>39   | 25.5<br>24.8<br>23.8<br>24.0<br>22.6   | 214<br>210<br>197<br>195<br>180  |
| BCSS-1    |                                         |                                         |                              |                                        |                                  |
| Certified | $0.13 \pm 0.01$                         | $0.25 \pm 0.04$                         | $22.7 \pm 3.4$               | $18.5 \pm 2.7$                         | $119 \pm 12$                     |
| Found     | 0.17<br>0.14<br>0.18<br>0.18<br>0.18    | 0.21<br>0.31<br>0.24<br>0.23<br>0.25    | 31<br>30<br>35<br>35<br>37   | 16.4<br>16.3<br>17.4<br>17.6<br>17.9   | 118<br>119<br>117<br>119<br>128  |

\* All results expressed as ug/g dry weight

DUMPSITE: FIVE FINGER  
NUMBER: 40  
CO-ORDINATES: 49°15.20'N 123°54.60'W  
DEPTH: 280 metres  
TOTAL QUANTITY  
DUMPED: 111 812 cubic metres  
LOADSITE INFORMATION:

The Five Finger dumpsite was first used in 1978 when the Dorman Pulp Chip Co. Ltd. dredged to expand their log booming ground in the Nanaimo estuary (O.D.C.A. file no. -00456). Approximately 46,000 cubic metres of river and marine sediments containing woodwastes were dumped. The dumpsite designated for this material was about 1 nautical mile east of the current site. In 1979, MacMillan Bloedel dredged at their Harmac pulpmill and dumped 60,000 cubic metres of marine sediments, woodwastes and flyash (charcoal). In the last ten years, various projects have been proposed by Public Works Canada (P.W.C.) in Nanaimo Harbour; however, all but one have been cancelled or indefinitely postponed. In 1981, P.W.C. dredged the Government Assembly Wharf dock (O.D.C.A. file No. -01006) and ocean dumped 5,500 cubic metres of mud, silt and sand. Samples were collected by Environmental Protection prior to dredging and analysed for cadmium, mercury, lead and polychlorinated biphenyl. The analytical results indicated no significant contamination.

The Department of Fisheries and Oceans generally prohibit dredging activities in Nanaimo Harbour and Newcastle Island Passage during the period March 1 to June 30 to protect juvenile salmon rearing in and migrating through the area. Herring spawn in shallow waters around Nanaimo in March.

**RESEARCH INFORMATION:**

No research information available.

**MONITORING INFORMATION:**

A benthic sediment survey was conducted in July 1986 (Figure 13) (Table 8).

A Pisces IV dive was completed in November 1983 (Appendix II). A bottom type and resident benthos typical of the Strait of Georgia was observed. Evidence of dumping did not indicate any impact on resident biota.



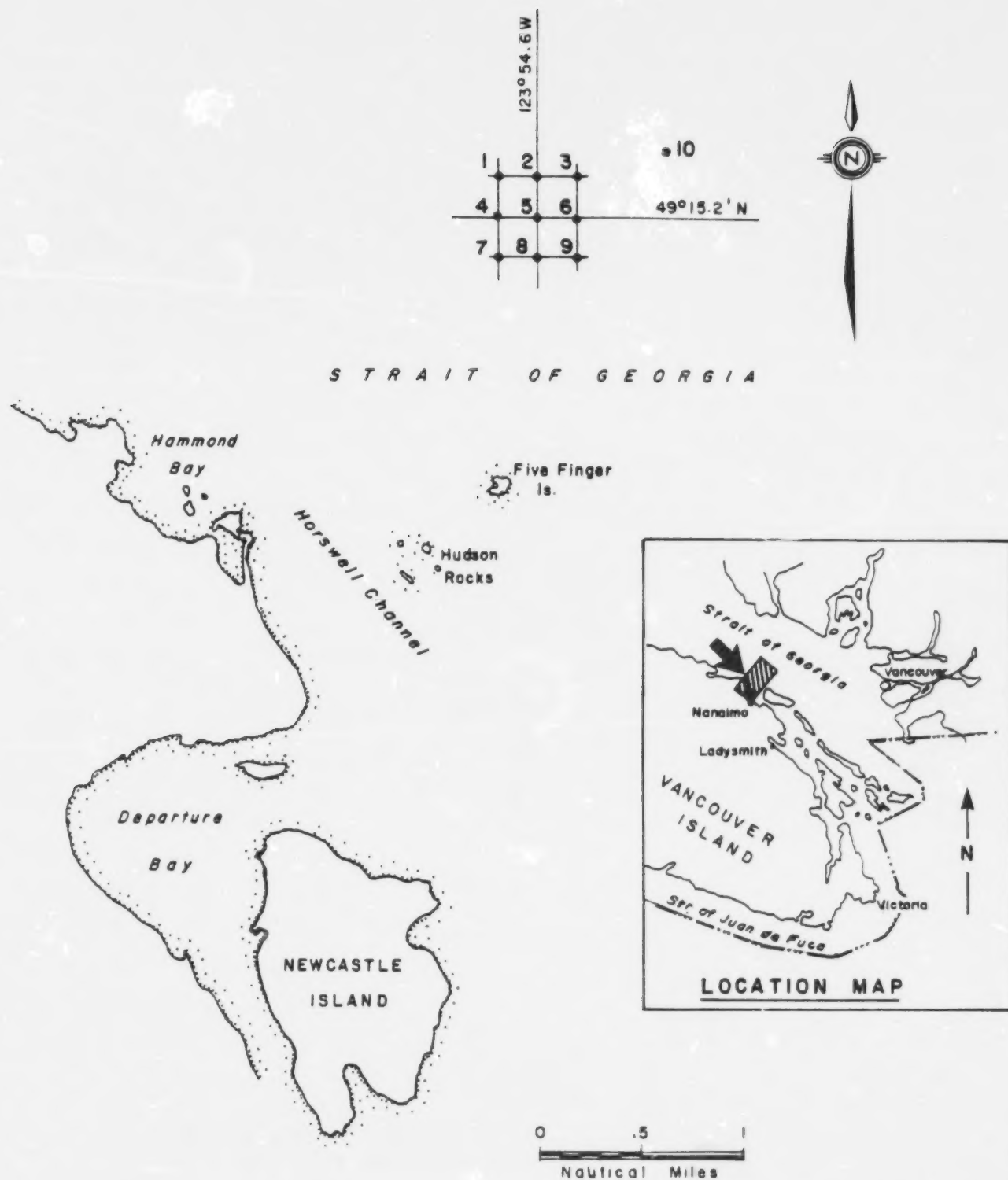


FIGURE 13 FIVE FINGER ISLAND OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

**TABLE 8** FIVE FINGERS OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB AND CORE SAMPLES - JULY 1986

| STATION         | Hg                                             | Cd                                             | Pb                                  | Cu                                             | Zn                                       |
|-----------------|------------------------------------------------|------------------------------------------------|-------------------------------------|------------------------------------------------|------------------------------------------|
| 1               | 0.20<br>0.23<br>0.21<br><u>0.21</u> $\pm$ 0.02 | 0.53<br>0.44<br>1.47<br><u>0.81</u> $\pm$ 0.58 | 46<br>43<br>37<br><u>42</u> $\pm$ 5 | 70.3<br>66.9<br>60.7<br><u>66.0</u> $\pm$ 4.9  | 172<br>172<br>161<br><u>168</u> $\pm$ 6  |
| 2               | 0.14<br>0.14<br>0.13<br><u>0.14</u> $\pm$ 0.01 | 2.07<br>0.65<br>1.45<br><u>1.39</u> $\pm$ 0.71 | 31<br>27<br>30<br><u>29</u> $\pm$ 2 | 50.6<br>49.9<br>52.1<br><u>50.9</u> $\pm$ 1.1  | 144<br>135<br>129<br><u>136</u> $\pm$ 8  |
| 3               | 0.12<br>0.13<br>0.11<br><u>0.12</u> $\pm$ 0.01 | 0.50<br>0.48<br>0.42<br><u>0.47</u> $\pm$ 0.04 | 40<br>40<br>42<br><u>41</u> $\pm$ 1 | 45.5<br>47.8<br>45.9<br><u>46.4</u> $\pm$ 1.2  | 154<br>151<br>154<br><u>153</u> $\pm$ 2  |
| 4               | 0.19<br>0.19<br>0.18<br><u>0.18</u> $\pm$ 0.01 | 0.71<br>0.46<br>0.42<br><u>0.53</u> $\pm$ 0.16 | 38<br>42<br>40<br><u>40</u> $\pm$ 2 | 65.0<br>64.0<br>59.8<br><u>62.9</u> $\pm$ 2.8  | 157<br>155<br>143<br><u>152</u> $\pm$ 8  |
| 5               | 0.19<br>0.17<br>0.19<br><u>0.18</u> $\pm$ 0.01 | 0.55<br>0.94<br>0.97<br><u>0.82</u> $\pm$ 0.23 | 43<br>38<br>33<br><u>38</u> $\pm$ 5 | 62.3<br>59.5<br>58.8<br><u>60.2</u> $\pm$ 1.9  | 167<br>165<br>166<br><u>166</u> $\pm$ 1  |
| 5<br>(Depth-cm) |                                                |                                                |                                     |                                                |                                          |
| 30-40           | 0.10                                           | 0.67                                           | 24                                  | 48.6                                           | 115                                      |
| 60-70           | 0.08                                           | 0.94                                           | 24                                  | 46.7                                           | 114                                      |
| 90-100          | 0.11                                           | 0.96                                           | 26                                  | 46.6                                           | 117                                      |
| 120-130         | 0.10                                           | 1.31                                           | 26                                  | 48.3                                           | 118                                      |
| 150-160         | 0.09                                           | 0.78                                           | 26                                  | 46.5                                           | 115                                      |
| 6               | 0.17<br>0.16<br>0.18<br><u>0.17</u> $\pm$ 0.01 | 0.55<br>0.50<br>0.63<br><u>0.56</u> $\pm$ 0.07 | 36<br>44<br>46<br><u>42</u> $\pm$ 5 | 44.7<br>74.2<br>65.4<br><u>61.4</u> $\pm$ 15.1 | 150<br>168<br>166<br><u>161</u> $\pm$ 10 |

\* All results expressed as ug/g dry weight

TABLE 8 (Continued)

| STATION   | Hg                 | Cd                 | Pb            | Cu                 | Zn                |
|-----------|--------------------|--------------------|---------------|--------------------|-------------------|
| 7         | 0.18               | 1.36               | 43            | 65.2               | 144               |
|           | 0.21               | 0.61               | 39            | 63.1               | 159               |
|           | 0.20               | 0.57               | 42            | 65.1               | 158               |
|           | <u>0.20</u> ± 0.01 | <u>0.85</u> ± 0.45 | <u>41</u> ± 2 | <u>64.5</u> ± 1.2  | <u>154</u> ± 8    |
|           |                    |                    |               |                    |                   |
| 8         | 0.18               | 0.70               | 38            | 49.2               | 146               |
|           | 0.31               | 1.18               | 41            | 55.6               | 146               |
|           | 0.17               | 6.8                | 37            | 50.8               | 140               |
|           | <u>0.22</u> ± 0.08 | <u>2.9</u> ± 3.3   | <u>39</u> ± 2 | <u>51.9</u> ± 3.3  | <u>144</u> ± 3    |
|           |                    |                    |               |                    |                   |
| 9         | 0.19               | 0.98               | 45            | 69.2               | 172               |
|           | 0.18               | 0.49               | 38            | 61.1               | 155               |
|           | 0.18               | 0.64               | 42            | 48.6               | 156               |
|           | <u>0.18</u> ± 0.01 | <u>0.70</u> ± 0.25 | <u>42</u> ± 4 | <u>60.0</u> ± 10.4 | <u>161</u> ± 10.0 |
|           |                    |                    |               |                    |                   |
| 10        | 0.15               | 1.55               | 43            | 64.4               | 163               |
|           | 0.18               | 0.68               | 39            | 63.4               | 160               |
|           | 0.17               | 0.51               | 43            | 64.4               | 164               |
|           | <u>0.17</u> ± 0.02 | <u>0.91</u> ± 0.56 | <u>42</u> ± 2 | <u>64.1</u> ± 0.6  | <u>162</u> ± 2    |
|           |                    |                    |               |                    |                   |
| MESS-1    |                    |                    |               |                    |                   |
| Certified | 0.17 ± 0.01        | 0.59 ± 0.10        | 34.0 ± 6.1    | 25.1 ± 3.8         | 191 ± 17          |
| Found     | 0.25               | 0.62               | 36            | 22.9               | 198               |
|           | 0.24               | 0.61               | 38            | 21.5               | 192               |
|           | 0.26               | 0.60               | 35            | 20.9               | 176               |
|           | 0.22               | 0.62               | 36            | 20.5               | 171               |
|           | 0.23               | 0.60               | 40            | 25.6               | 181               |
| BCSS-1    |                    |                    |               |                    |                   |
| Certified | 0.13 ± 0.01        | 0.25 ± 0.04        | 22.7 ± 3.4    | 18.5 ± 2.7         | 119 ± 12          |
| Found     | 16                 | 0.22               | 34            | 16.8               | 119               |
|           | 19                 | 0.19               | 34            | 16.4               | 121               |
|           | 19                 | 0.21               | 36            | 16.4               | 119               |
|           | 18                 | 0.20               | 35            | 16.9               | 120               |
|           | 19                 | 0.21               | 33            | 16.2               | 120               |

\* All results expressed as ug/g dry weight

DUMPSITE: FRENCH CREEK  
NUMBER: 44  
CO-ORDINATES: 49°22.50'N 124°19.00'W  
DEPTH: 200 metres  
TOTAL QUANTITY  
DUMPED: 30 500 cubic metres  
LOADSITE INFORMATION:

The French Creek dump site has been used on two occasions by Public Works Canada (P.W.C.) for improvements to the French Creek boat harbour. In 1978, P.W.C. dredged and dumped 15 000 cubic metres of sand and gravel from the entrance to the harbour. In 1984, the harbour was expanded requiring removal of another 10 000 cubic metres of sand and gravel. Prior to approval for the latter project, Environmental Protection collected samples for chemical analysis of cadmium, mercury, lead, arsenic and polychlorinated biphenyl. The material appeared to be clean creek bed sediments with no indication of contamination.

The Department of Fisheries and Oceans generally prohibits dredging near French Creek from March 1 to June 30 to protect the downstream migration of juvenile salmon and the herring spawn and emergent larvae.

**RESEARCH INFORMATION:**

No research information available.

DUMPSITE: COMOX  
NUMBER: 48  
CO-ORDINATES: 49°41.70'N 124°44.50'W  
DEPTH: 190 metres  
TOTAL QUANTITY  
DUMPED: 2 218 cubic metres  
LOADSITE INFORMATION:

The Comox dumpsite was designated in 1977 for the disposal of 900 cubic metres of sand dredged from the Little River Ferry terminal by Public Works Canada. The boat harbour in Comox was dredged in 1981-82 requiring the disposal of 1,300 cubic metres of mud, sand and gravel (O.D.C.A. file no. -01212). Prior to the dredging in Comox, Environmental Protection collected sediment samples to analyze for cadmium, mercury, lead, arsenic and polychlorinated biphenyl. The analytical results indicated no contamination.

The Department of Fisheries and Oceans generally prohibit dredging in the Comox area from February 15 to August 1 to protect rearing salmon fry and hatchery releases of juvenile salmon and steelhead. It was recommended that dredging in the Little River area not begin until December 1 to avoid interference with the coho salmon migration and the associated sport fishery.

RESEARCH INFORMATION:

No research information available.

DUMPSITE: MALASPINA  
NUMBER: 49  
CO-ORDINATES: 49°45.00'N 124°27.00'W  
DEPTH: 320 metres  
TOTAL QUANTITY  
DUMPED: 138 891 cubic metres  
COMMENTS:

Site designated in May 1980. Previously known as Powell River.

**LOADSITE INFORMATION:**

Most of the material dumped at the Malaspina site originates from annual maintenance dredging at the MacMillan Bloedel Pulpmill at Powell River. The Department of Fisheries and Oceans generally restrict dredging and loading activities at the pulpmill to the period June 15 to July 31 to protect fishery resources.

In addition to containing a large amount of wood debris and fibre, the sediments in the vicinity of the pulpmill often contain elevated levels of cadmium (1 to 2 ug/g) and occasionally high levels of mercury. It is thought that the cadmium, commonly found in association with zinc, may have resulted from the use of zinc dithionite as a pulp bleaching agent prior to 1971. Elevated levels of mercury in sediments appear to be patchy and may have resulted from the historical practice using mercurial compounds to control slimes on logs and in paper making processes. This practice was discontinued around 1960.

Sediment sampling at the Malaspina dumpsite prior to its use showed elevated levels of cadmium between 1 and 2 ug/g. Disposal of spoils from Powell River are therefore approved for disposal on the basis of 'like-on-like', however, MacMillan Bloedel continues to monitor the dredge scows as a requirement of approval.

In 1986, a scow containing crushed limestone was dumped at the Malaspina site when an emergency situation arose and it was felt that the scow might be lost.

#### RESEARCH INFORMATION:

Contaminated sediments from the Powell River pulpmill have been used in two studies (O.D.C.A.R.F. 7.2.2, 8.2.4) involving the rate of uptake and bioaccumulation of contaminants. Two species of polychaete and one species of clam (Macoma balthica) were exposed in laboratory tanks. Although the results were variable between species and with different contaminants, they did suggest that cadmium was being taken up by M. balthica in the lab and this was confirmed by elevated levels in resident biota (polychaete worms, sole liver) at the pulpmill. Amphipod bioassays on Powell River pulpmill sediments (Chapman and Barlow 1984), although showing no acute toxicity, did suggest a high level of avoidance ie: sublethal effect. Additional amphipod bioassays with sediments from various locations at the pulpmill will be run in 1987 (O.D.C.A.R.F. 13.2.2).

#### MONITORING INFORMATION:

Benthic sediment surveys were conducted in June 1980, April and October 1984 (Figure 14).

Background cadmium levels prior to dumping were in excess of the O.D.C.A. scheduled criteria at this location, (0.87 - 1.23 ug/g), even to depth in core samples. No noticeable trends of increase in scheduled trace metals have been recorded to date (Tables 9, 10 and 11).

A Pisces IV dive was completed at the dumpsite in March 1980. Dive records indicate that benthos was fairly diverse although not abundant. Dominant organisms were side stripe shrimp (Pandalopsis dispar) and Dover sole (Microstomus pacificus). The flat bottom of soft clay-like material underlying light brown sediments showed evidence of relatively strong bottom currents (Petrie & Holman, 1983). A subsequent dive in



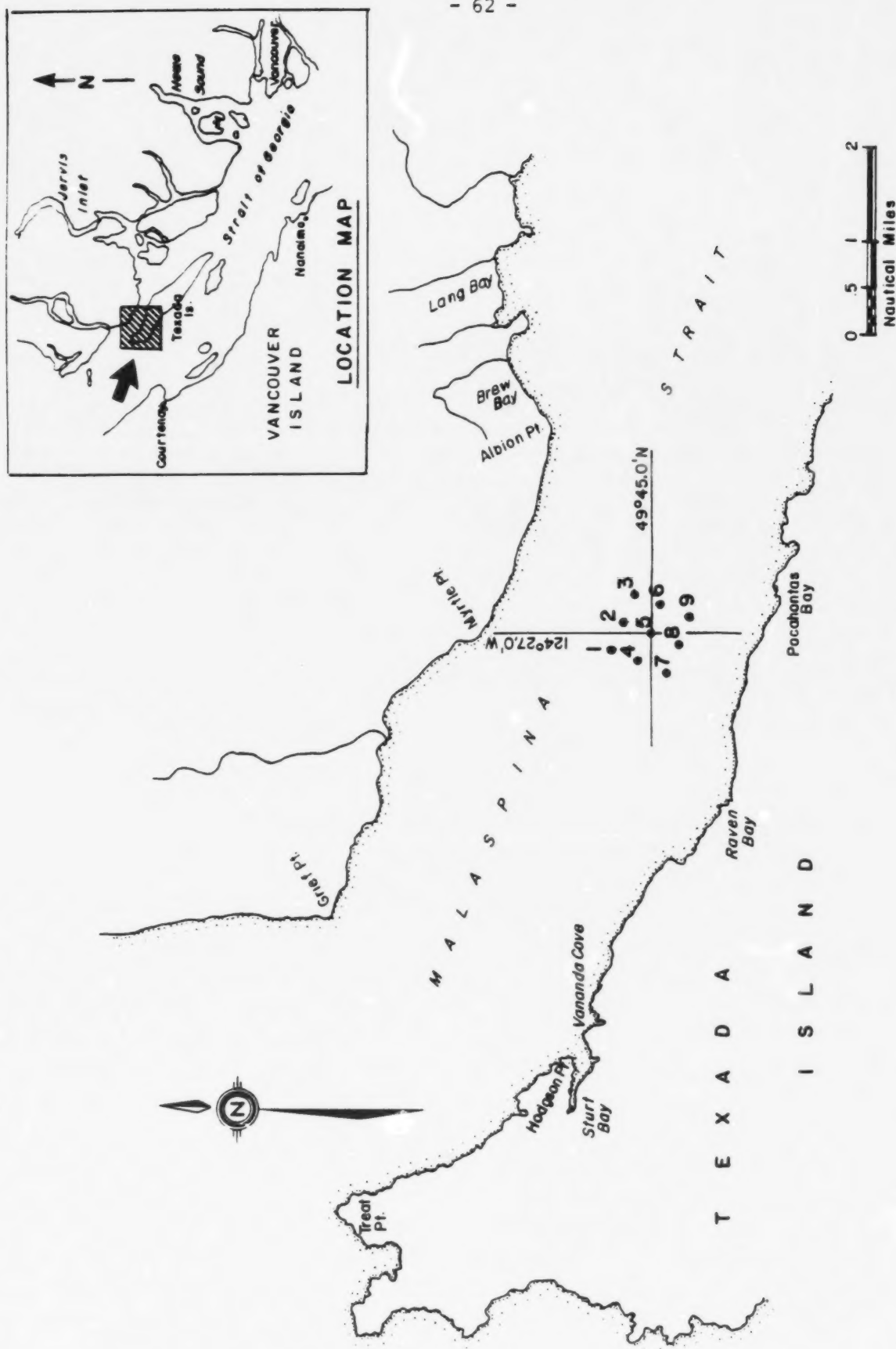


FIGURE 14 MALASPINA STRAIT OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

December 1984 (Appendix II) confirmed the observations made in 1980. Of interest was the bacterial slimie noted on all wood material in the dump site area.

Further surveys of benthic sediment chemistry are planned for 1987.

**TABLE 9** MALASPINA STRAIT OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - GRAB SAMPLES - JUNE 1980

| STATION | Hg           | Cd   | Pb   | Cu   | Zn    |
|---------|--------------|------|------|------|-------|
| 1       | 0.353        | 0.87 | 86.5 | 80.0 | 159.0 |
| 2       | N.D.(.196)** | 1.01 | 85.5 | 84.0 | 196.0 |
| 3       | 0.363        | 1.10 | 86.2 | 84.1 | 192.0 |
| 4       | 0.353        | 0.96 | 92.5 | 91.0 | 205.0 |
| 5       | 0.335        | 1.17 | 88.5 | 87.0 | 182.0 |
| 6       | 0.463        | 1.23 | 90.0 | 86.5 | 205.0 |
| 7       | N.D.(.192)   | 1.17 | 88.5 | 89.5 | 189.0 |
| 8       | N.D.(.192)   | 1.23 | 87.5 | 90.5 | 196.0 |
| 9       | N.D.(.182)   | 1.22 | 89.0 | 87.0 | 182.0 |

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\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

TABLE 10 MALASPINA STRAIT OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB AND CORE SAMPLES - APRIL 1984

| STATION    | Hg                                            | Cd                                  | Pb                            | Cu                                      | Zn                                 |
|------------|-----------------------------------------------|-------------------------------------|-------------------------------|-----------------------------------------|------------------------------------|
| 1          | 0.102<br>0.095<br>0.095<br><u>0.097+0.004</u> | 1.1<br>0.8<br>0.7<br><u>0.9+0.2</u> | 29<br>31<br>29<br><u>30+1</u> | 86.1<br>86.8<br>91.1<br><u>88.0+2.7</u> | 210<br>198<br>206<br><u>205+6</u>  |
| 2          | 0.089<br>0.070<br>0.083<br><u>0.080+0.010</u> | 0.7<br>0.6<br>0.8<br><u>0.7+0.1</u> | 30<br>28<br>29<br><u>29+1</u> | 87.8<br>86.7<br>88.9<br><u>87.8+1.1</u> | 202<br>201<br>216<br><u>206+8</u>  |
| 3          | 0.083<br>0.096<br>0.077<br><u>0.085+0.010</u> | 0.5<br>1.0<br>2.0<br><u>1.2+0.8</u> | 26<br>30<br>30<br><u>29+2</u> | 88.9<br>94.5<br>90.4<br><u>91.3+2.9</u> | 212<br>209<br>203<br><u>208+5</u>  |
| 4          | 0.064<br>0.064<br>0.076<br><u>0.068+0.007</u> | 0.9<br>0.7<br>0.9<br><u>0.8+0.1</u> | 31<br>27<br>30<br><u>29+2</u> | 94.0<br>88.5<br>92.9<br><u>91.8+2.9</u> | 237<br>206<br>214<br><u>219+16</u> |
| 5          | 0.077<br>0.070<br>0.089<br><u>0.078+0.010</u> | 1.0<br>1.1<br>1.0<br><u>1.0+0.1</u> | 31<br>32<br>29<br><u>31+2</u> | 92.6<br>94.5<br>92.1<br><u>93.1+1.3</u> | 214<br>235<br>207<br><u>219+15</u> |
| 5          |                                               |                                     |                               |                                         |                                    |
| 0-10 cm    | 0.051                                         | 1.0                                 | 20                            | 83.1                                    | 176                                |
| 30-40 cm   | 0.038                                         | 0.7                                 | 4                             | 53.9                                    | 119                                |
| 60-70 cm   | 0.038                                         | 0.9                                 | 7                             | 52.0                                    | 115                                |
| 170-180 cm | 0.032                                         | 0.9                                 | N.D.(3)**                     | 56.5                                    | 125                                |
| 6          | 0.070<br>0.070<br>0.077<br><u>0.072+0.004</u> | 0.6<br>0.9<br>0.8<br><u>0.8+0.2</u> | 27<br>27<br>29<br><u>28+1</u> | 92.0<br>89.0<br>91.2<br><u>90.7+1.6</u> | 213<br>217<br>216<br><u>215+2</u>  |
| 7          | 0.064<br>0.076<br>0.064<br><u>0.070+0.010</u> | 0.8<br>0.9<br>1.1<br><u>0.9+0.2</u> | 27<br>29<br>29<br><u>28+1</u> | 95.6<br>98.0<br>96.8<br><u>96.8+1.2</u> | 212<br>205<br>208<br><u>208+4</u>  |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

TABLE 10 (Continued)

| STATION   | Hg                                             | Cd                                   | Pb                             | Cu                                        | Zn                                 |
|-----------|------------------------------------------------|--------------------------------------|--------------------------------|-------------------------------------------|------------------------------------|
| 8         | 0.083<br>0.082<br>0.077<br><u>0.080</u> +0.003 | 1.0<br>0.6<br>1.0<br><u>0.9</u> +0.2 | 31<br>30<br>32<br><u>31</u> +1 | 100.0<br>97.0<br>96.8<br><u>97.9</u> +1.8 | 214<br>214<br>217<br><u>215</u> +2 |
| 9         | 0.083<br>0.070<br>0.064<br><u>0.072</u> +0.010 | 0.5<br>0.5<br>0.5<br><u>0.5</u> +0.0 | 20<br>23<br>23<br><u>22</u> +2 | 77.7<br>77.3<br>76.9<br><u>77.3</u> +0.4  | 171<br>168<br>174<br><u>171</u> +3 |
| MESS-1    |                                                |                                      |                                |                                           |                                    |
| Certified | <u>0.17</u> +0.01                              | <u>0.59</u> +0.1                     | <u>34.0</u> +6.1               | <u>25.1</u> +3.8                          | <u>191</u> +17                     |
| Found     | 0.178<br>0.189<br>0.177                        | 0.5<br>0.5<br>0.4                    | 28<br>29<br>31                 | 23.7<br>23.6<br>24.6                      | 195<br>198<br>187                  |
| BCSS-1    |                                                |                                      |                                |                                           |                                    |
| Certified | <u>0.13</u> +0.01                              | <u>0.25</u> +0.04                    | <u>22.7</u> +3.4               | <u>18.5</u> +2.7                          | <u>119</u> +12                     |
| Found     | 0.134<br>0.123<br>0.123                        | N.D.(.3)<br>N.D.(.3)<br>N.D.(.3)     | 19<br>18<br>20                 | 16.5<br>16.3<br>16.5                      | 119<br>114<br>115                  |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

**TABLE 11** MALASPINA STRAIT OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB SAMPLES - OCTOBER 1984

| STATION | Hg                                             | Cd                                             | Pb                                  | Cu                                  | Zn                                       |
|---------|------------------------------------------------|------------------------------------------------|-------------------------------------|-------------------------------------|------------------------------------------|
| MS-1    | 0.20<br>0.19<br>0.18<br><u>0.19</u> $\pm$ 0.01 | 1.00<br>0.88<br>0.86<br><u>0.91</u> $\pm$ 0.08 | 57<br>49<br>44<br><u>50</u> $\pm$ 7 | 87<br>87<br>81<br><u>85</u> $\pm$ 4 | 199<br>197<br>184<br><u>193</u> $\pm$ 8  |
| MS-2    | 0.19<br>0.18<br>0.17<br><u>0.18</u> $\pm$ 0.01 | 0.85<br>0.93<br>0.77<br><u>0.85</u> $\pm$ 0.08 | 49<br>52<br>43<br><u>48</u> $\pm$ 5 | 87<br>88<br>79<br><u>85</u> $\pm$ 5 | 196<br>198<br>178<br><u>191</u> $\pm$ 1  |
| MS-3    | 0.18<br>0.18<br>0.20<br><u>0.19</u> $\pm$ 0.01 | 0.90<br>1.04<br>0.86<br><u>0.93</u> $\pm$ 0.09 | 42<br>48<br>46<br><u>45</u> $\pm$ 3 | 84<br>88<br>88<br><u>87</u> $\pm$ 2 | 189<br>194<br>188<br><u>190</u> $\pm$ 31 |
| MS-4    | 0.17<br>0.21<br>0.21<br><u>0.20</u> $\pm$ 0.02 | 0.77<br>0.86<br>0.82<br><u>0.82</u> $\pm$ 0.05 | 43<br>41<br>43<br><u>42</u> $\pm$ 1 | 80<br>84<br>73<br><u>79</u> $\pm$ 6 | 174<br>189<br>170<br><u>178</u> $\pm$ 1  |
| MS-5    | 0.21<br>0.24<br>0.20<br><u>0.22</u> $\pm$ 0.02 | 0.89<br>0.89<br>0.80<br><u>0.86</u> $\pm$ 0.05 | 44<br>44<br>45<br><u>44</u> $\pm$ 1 | 86<br>88<br>82<br><u>85</u> $\pm$ 3 | 192<br>194<br>183<br><u>190</u> $\pm$ 60 |
| MS-6    | 0.23<br>0.30<br>0.28<br><u>0.27</u> $\pm$ 0.04 | 0.97<br>1.11<br>0.97<br><u>1.02</u> $\pm$ 0.08 | 45<br>49<br>46<br><u>47</u> $\pm$ 2 | 85<br>95<br>94<br><u>91</u> $\pm$ 6 | 199<br>229<br>216<br><u>215</u> $\pm$ 15 |
| MS-7    | 0.29<br>0.30<br>0.28<br><u>0.29</u> $\pm$ 0.01 | 0.94<br>3.10<br>1.30<br><u>1.78</u> $\pm$ 1.16 | 38<br>34<br>38<br><u>37</u> $\pm$ 2 | 89<br>78<br>86<br><u>84</u> $\pm$ 6 | 185<br>169<br>175<br><u>176</u> $\pm$ 8  |

\* All results expressed in ug/g dry weight

TABLE 11 (Continued)

| STATION   | Hg                                                                   | Cd                                                                   | Pb                                                 | Cu                                                 | Zn                                                          |
|-----------|----------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------|----------------------------------------------------|-------------------------------------------------------------|
| MS-8      | 0.29<br>0.25<br>0.28<br><u>0.27</u> $\pm$ 0.02                       | 1.01<br>0.84<br>0.88<br><u>0.91</u> $\pm$ 0.09                       | 41<br>36<br>40<br><u>39</u> $\pm$ 3                | 95<br>84<br>92<br><u>90</u> $\pm$ 6                | 212<br>177<br>193<br><u>194</u> $\pm$ 18                    |
| MS-9      | 0.27<br>0.22<br>0.30<br><u>0.26</u> $\pm$ 0.04                       | 0.79<br>0.57<br>0.71<br><u>0.69</u> $\pm$ 0.11                       | 35<br>23<br>35<br><u>31</u> $\pm$ 7                | 82<br>64<br>86<br><u>77</u> $\pm$ 6                | 179<br>139<br>171<br><u>163</u> $\pm$ 21                    |
| MESS-1    |                                                                      |                                                                      |                                                    |                                                    |                                                             |
| Certified | 0.17 $\pm$ 0.01                                                      | 0.59 $\pm$ 0.10                                                      | 34 $\pm$ 6                                         | 25 $\pm$ 4                                         | 191 $\pm$ 17                                                |
| Found     | 0.21<br>0.21<br>0.21<br>0.20<br>0.18<br>0.19<br>0.19<br>0.19<br>0.19 | 0.57<br>0.51<br>0.44<br>0.49<br>0.50<br>0.46<br>0.62<br>0.56<br>0.44 | 34<br>33<br>33<br>28<br>34<br>37<br>31<br>38<br>37 | 25<br>25<br>22<br>23<br>23<br>24<br>21<br>23<br>24 | 176<br>182<br>167<br>164<br>182<br>181<br>161<br>175<br>181 |
| BCSS-1    |                                                                      |                                                                      |                                                    |                                                    |                                                             |
| Certified | 0.13 $\pm$ 0.01                                                      | 0.24 $\pm$ 0.04                                                      | 23 $\pm$ 3                                         | 18 $\pm$ 3                                         | 119 $\pm$ 12                                                |
| Found     | 0.23<br>0.13<br>0.18<br>0.15<br>0.15<br>0.13<br>0.14<br>0.15<br>0.15 | 0.51<br>0.21<br>0.26<br>0.28<br>0.38<br>0.26<br>0.25<br>0.29<br>0.26 | 32<br>16<br>22<br>30<br>24<br>26<br>26<br>25<br>-  | 23<br>12<br>15<br>18<br>16<br>15<br>15<br>17<br>-  | 170<br>82<br>99<br>111<br>105<br>100<br>98<br>108<br>-      |

\* All results expressed in ug/g dry weight



DUMPSITE: THORNBROUGH CHANNEL  
NUMBER: 64  
CO-ORDINATES: 49°31.00'N 123°28.20'W  
DEPTH: 220 metres  
TOTAL QUANTITY  
DUMPED: 37 846 cubic metres  
COMMENTS:

Site previously referred to as Howe Sound.

**LOADSITE INFORMATION:**

The Thornbrough Channel dumpsite has been for the exclusive use of the Canadian Forest Products, Port Mellon pulpmill. Fisheries and Oceans advise that juvenile salmon migrating from the Squamish River utilize nearshore areas around the pulpmill from mid-February to late June. Therefore, dredging/loading activities should avoid this period.

The mill has not had a requirement to dredge for several years; however, sediment sampling prior to a dredging operation in 1981 revealed extremely high levels of cadmium. A mean value of about 5 ug/g was reported for sediments from near the mouth of the Rainy River where it was proposed to excavate a trench for placement of an outfall diffuser. Based on these data, the application to dispose of spoils at the dumpsite was rejected. The material was subsequently dumped in an adjacent deeper area which was similarly contaminated. Based on amphipod bioassays run in 1984 (Chapman and Barlow 1984), the sediments from the Port Mellon dock area were toxic, and from the scow loading area, non-toxic. Dredged material from the mill, which has been disposed at the dumpsite, consisted of mainly wood debris including bark, chips and fiber.

#### RESEARCH INFORMATION:

Sediment sampling, bottom trawling and Pisces IV observations have all demonstrated the relatively high level of wood debris in Thornbrough Channel. Various studies have shown that the impact of sediments with a high organic loading is to reduce species diversity and possibly abundance of benthic animals. Woodwaste was collected from the chip loading dock at Port Mellon for use in studies (O.D.C.A.R.F. 9.2.3, 10.2.3) to determine the effects of woodwaste on the recruitment of marine macrobenthic communities. The former study suggested that community enhancement may occur between 10% and 40% wood content while higher content was detrimental to recruitment. The latter study demonstrated that while abundance was greatest with intermediate thicknesses of woodwaste, species diversity decreased with increasing thicknesses.

#### MONITORING INFORMATION:

Benthic sediment surveys were conducted in March 1982 and April 1984 (Figure 15). The highest cadmium and zinc concentrations were found at the stations in closest proximity to the mill, which suggests the source of both trace metals is the pulpmill at Port Mellon ( cadmium 0.3 to 3.8 ug/g; zinc - 82.4 to 238.0 ug/g) (Tables 12 and 13).

Pisces IV dives were completed in Thornbrough Channel in January 1976. Dive records are not available.

A benthic sediment survey has been planned for this site in 1987 to corroborate previous trace metal data.

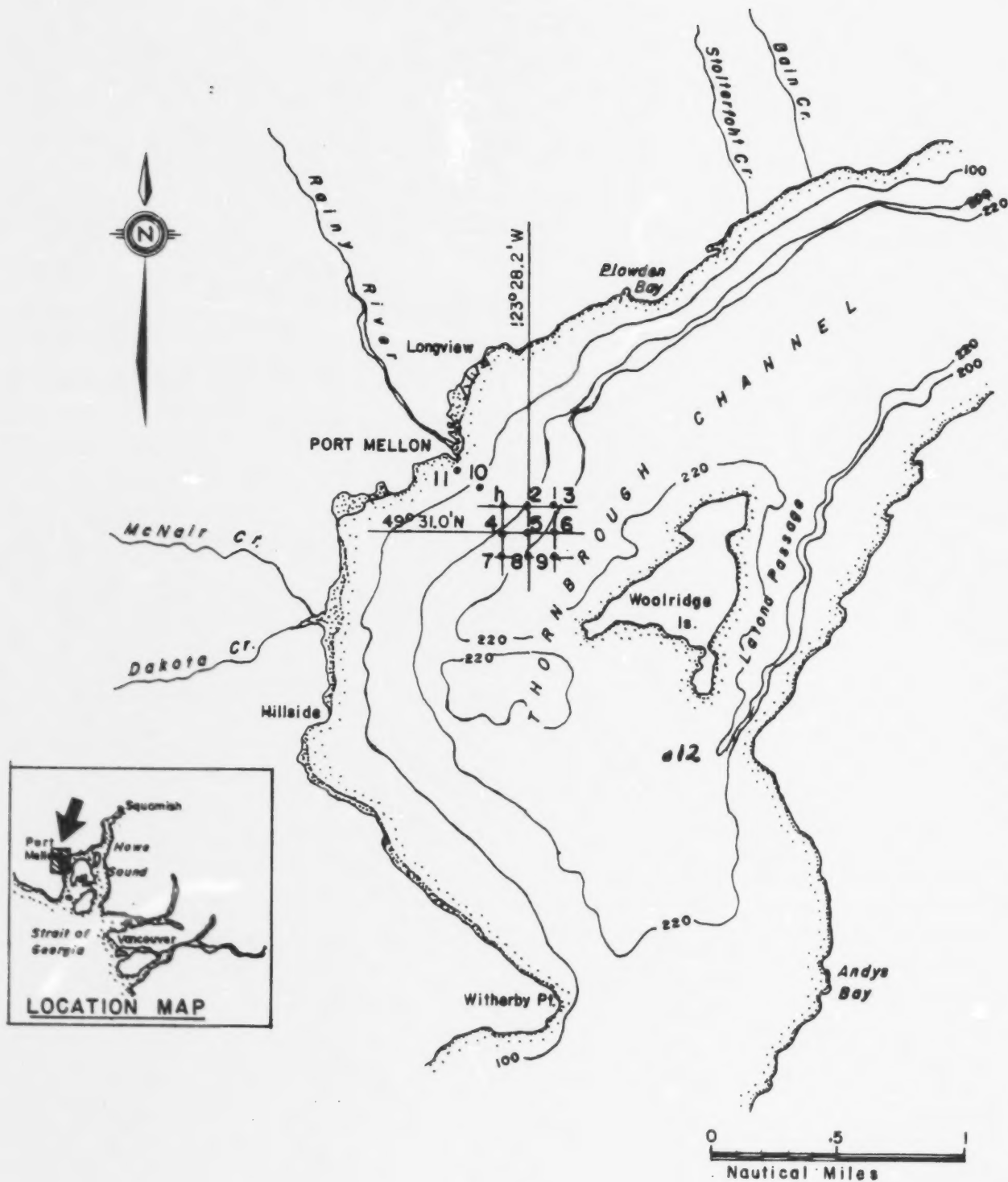


FIGURE 15 THORNBROUGH CHANNEL OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

**TABLE 12** THORNBROUGH CHANNEL OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - GRAB AND CORE SAMPLES - MARCH 1982

| STATION    | Hg   | Cd  | Pb | Cu    | Zn    |
|------------|------|-----|----|-------|-------|
| 1          | 0.41 | 0.6 | 29 | 70.1  | 83.9  |
| 2          | 0.24 | 0.5 | 24 | 56.8  | 75.1  |
| 3          | 0.34 | 0.4 | 20 | 44.8  | 66.7  |
| 4          | 0.47 | 0.8 | 30 | 77.5  | 103.  |
| 5          |      |     |    |       |       |
| 0-10 cm    | 0.29 | 0.7 | 32 | 92.1  | 126.  |
| 30-40 cm   | 0.18 | 0.5 | 15 | 43.0  | 76.1  |
| 60-70 cm   | 0.19 | 0.5 | 12 | 40.8  | 69.9  |
| 90-100 cm  | 0.14 | 0.5 | 11 | 30.1  | 57.5  |
| 120-130 cm | 0.19 | 0.4 | 11 | 33.4  | 56.6  |
| 6          | 0.38 | 0.4 | 25 | 63.0  | 82.1  |
| 7          | 0.34 | 0.7 | 28 | 68.9  | 87.5  |
| 8          | 0.37 | 0.5 | 29 | 73.6  | 96.1  |
| 9          | 0.46 | 0.5 | 28 | 69.5  | 93.0  |
| 10         | 0.40 | 1.0 | 47 | 108.0 | 141.0 |
| 11         | 0.42 | 2.2 | 34 | 98.5  | 206.0 |
| 12         | 0.73 | 0.4 | 42 | 134.0 | 170.0 |

\* All results expressed in ug/g dry weight

**TABLE 13** THORNBROUGH CHANNEL OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB AND CORE SAMPLES - APRIL 1984

| STATION    | Hg                                             | Cd                                   | Pb                              | Cu                                        | Zn                                           |
|------------|------------------------------------------------|--------------------------------------|---------------------------------|-------------------------------------------|----------------------------------------------|
| 1          | 0.121<br>0.064<br>0.102<br><u>0.095</u> +0.030 | 1.0<br>1.0<br>0.7<br><u>0.9</u> +0.2 | 45<br>34<br>35<br><u>38</u> +6  | 72.0<br>80.2<br>85.5<br><u>79.2</u> +6.8  | 138<br>122<br>133<br><u>131</u> +8           |
| 2          | 0.064<br>0.051<br>0.057<br><u>0.057</u> +0.006 | 0.6<br>0.8<br>0.8<br><u>0.7</u> +0.1 | 22<br>25<br>22<br><u>23</u> +2  | 60.0<br>60.6<br>60.4<br><u>60.3</u> +0.3  | 91.0<br>95.2<br>92.1<br><u>92.7</u> +2.2     |
| 3          | 0.083<br>0.064<br>0.051<br><u>0.066</u> +0.016 | 3.8<br>N.D.(.3)**<br>0.5             | 18<br>16<br>15<br><u>16</u> +2  | 59.1<br>56.0<br>46.6<br><u>53.9</u> +6.5  | 92.7<br>93.9<br>79.4<br><u>88.6</u> +8.0     |
| 4          | 0.127<br>0.159<br>0.134<br><u>0.140</u> +0.020 | 0.9<br>0.9<br>1.1<br><u>1.0</u> +0.1 | 30<br>57<br>38<br><u>42</u> +14 | 84.8<br>96.7<br>99.5<br><u>93.6</u> +7.8  | 147<br>143<br>136<br><u>142</u> +6           |
| 5          | 0.114<br>0.057<br>0.083<br><u>0.085</u> +0.028 | 1.1<br>0.4<br>0.6<br><u>0.7</u> +0.4 | 29<br>15<br>22<br><u>22</u> +7  | 83.0<br>50.7<br>63.7<br><u>65.8</u> +16.3 | 127.0<br>82.4<br>104.0<br><u>104.5</u> +22.3 |
| 5          |                                                |                                      |                                 |                                           |                                              |
| 0-10 cm    | 0.126                                          | 0.6                                  | 28                              | 92.9                                      | 140.0                                        |
| 30-40 cm   | 0.038                                          | 0.5                                  | N.D.(3)                         | 45.1                                      | 97.9                                         |
| 60-70 cm   | 0.033                                          | N.D.(.3)                             | 4                               | 37.0                                      | 80.1                                         |
| 120-130 cm | 0.026                                          | N.D.(.3)                             | N.D.(3)                         | 29.3                                      | 57.4                                         |
| 6          | 0.096<br>0.070<br>0.070<br><u>0.079</u> +0.015 | 0.5<br>0.5<br>N.D.(.3)               | 23<br>21<br>22<br><u>22</u> +1  | 73.2<br>67.8<br>63.2<br><u>68.1</u> +5.0  | 112.0<br>103.0<br>97.4<br><u>104</u> +7.4    |

\* All results expressed in ug/g dry weight

\*\* Numbers in brackets are limits of detection

TABLE 13 (Continued)

| STATION   | Hg          | Cd        | Pb       | Cu        | Zn     |
|-----------|-------------|-----------|----------|-----------|--------|
| 7         | 0.134       | 0.7       | 29       | 84.7      | 126    |
|           | 0.127       | 0.7       | 32       | 87.7      | 124    |
|           | 0.127       | 0.7       | 32       | 86.9      | 132    |
|           | 0.129+0.004 | 0.7+0.0   | 31+2     | 86.4+1.6  | 127+4  |
|           |             |           |          |           |        |
| 8         | 0.115       | 0.3       | 27       | 87.1      | 129    |
|           | 0.101       | 0.4       | 29       | 91.2      | 135    |
|           | 0.115       | 0.5       | 29       | 91.1      | 132    |
|           | 0.11+0.010  | 0.4+0.1   | 28+1     | 89.9+2.3  | 132+3  |
|           |             |           |          |           |        |
| 9         | 0.102       | 0.5       | 24       | 83.2      | 130    |
|           | 0.121       | 0.5       | 24       | 83.4      | 129    |
|           | 0.108       | 0.5       | 27       | 85.6      | 135    |
|           | 0.11+0.010  | 0.5+0.0   | 25+2     | 84.1+1.3  | 131+3  |
|           |             |           |          |           |        |
| 10        | 0.113       | 2.6       | 226      | 278       | 222    |
|           | 0.083       | 2.4       | 157      | 212       | 238    |
|           | 0.120       | 2.0       | 146      | 265       | 217    |
|           | 0.105+0.020 | 2.3+0.3   | 176+4    | 251+35    | 226+11 |
|           |             |           |          |           |        |
| 11        | 0.051       | 3.1       | 24       | 93.9      | 114    |
|           | 0.057       | 0.6       | 39       | 99.2      | 129    |
|           | 0.038       | 0.7       | 27       | 77.8      | 101    |
|           | 0.049+0.010 | 1.5+1.4   | 31+8     | 90.3+11.1 | 115+14 |
|           |             |           |          |           |        |
| MESS-1    |             |           |          |           |        |
| Certified | 0.17+0.01   | 0.59+0.1  | 34.0+6.1 | 25.1+3.8  | 191+17 |
| Found     | 0.178       | 0.5       | 28       | 23.7      | 195    |
|           | 0.189       | 0.5       | 29       | 23.6      | 198    |
|           | 0.177       | 0.4       | 31       | 24.6      | 187    |
| BCSS-1    |             |           |          |           |        |
| Certified | 0.13+0.01   | 0.25+0.04 | 22.7+3.4 | 18.5+2.7  | 119+12 |
| Found     | 0.134       | N.D.(.3)  | 19       | 16.5      | 119    |
|           | 0.123       | N.D.(.3)  | 18       | 16.3      | 114    |
|           | 0.123       | N.D.(.3)  | 20       | 16.5      | 115    |

\* All results expressed in ug/g dry weight

|                |                        |
|----------------|------------------------|
| DUMPSITE:      | <u>WATTS POINT</u>     |
| NUMBER:        | 65                     |
| CO-ORDINATES:  | 49°38.50'N 123°14.00'W |
| DEPTH:         | 230 metres             |
| TOTAL QUANTITY |                        |
| DUMPED:        | 317 564 cubic metres   |
| COMMENTS:      |                        |

Site previously referred to as Howe Sound, Woodfibre.

#### LOADSITE INFORMATION:

The Watts Point dump site is used mainly for disposal of dredge spoils from the Western Pulp Limited Partnership (W.P.L.P.) pulpmill at Woodfibre (formerly owned by Rayonier) and from Mamquam Channel in the Squamish River estuary. Weldwood of Canada have two operations in the Mamquam Channel, Empire Lumber mill on the east side of the Channel and Empire Logging division on the west side which require periodic dredging. MacMillan Bloedel have a log dump and booming ground near the mouth of the Stawamus River which enters the south east part of the Channel. In addition to the dredging by forest industries, Public Works Canada has occasionally had to do maintenance dredging to keep the navigation channel open and maintain adequate depth at the public boat dock.

The Squamish estuary provides valuable habitat and migration routes for fishery resources including salmon, trout, herring and crab. The Department of Fisheries and Oceans generally restrict dredging activities to the period February 15 to March 31 in the Mamquam Channel and from January 15 to March 31 at the W.P.L.P. Woodfibre pulpmill. At both locations, the period August 1 to August 21 may also be approved based on circumstances and information provided by the proponent.



Mercury contamination of sediments in the Squamish estuary has been a concern for some time. Prior to 1970, the FMC chlor-alkali plant near the mouth of the Mamquam Channel released significant amounts of mercury into the estuary via its effluent stream. This led to the closure of upper Howe Sound to the taking of fish and shellfish for several years. Although sampling for analysis of mercury continues to be requested, data collected in recent years has not indicated a serious contamination problem in the areas requiring dredging.

Analyses for cadmium, lead, polychlorinated biphenyl (P.C.B.) and chlorophenols, penta- and tetra- (P.C.P. and T.C.P.) have also not indicated a problem. Chlorophenols have, in the past, been detected near the Empire Lumber mill where they are used in treating lumber; however, recent data have indicated low levels. No chemical contamination has been found in samples of material to be dredged from the Woodfibre pulpmill. The release of toxic hydrogen sulfide gas is a concern during the dredging of certain areas where woodwaste has accumulated over the years.

#### RESEARCH INFORMATION:

In 1972 an extensive sediment core and grab sampling study was undertaken in the northern end of Howe Sound to determine the distribution of mercury in the sediments (Thompson and McComas 1973). This followed the discovery of elevated levels of mercury in resident fish and shellfish. Areas of heavy contamination were identified and the authors recommended that these locations remain undisturbed by dredging and other forms of disruption.

Mercury mobilization studies in Howe Sound in 1976 (O.D.C.A.R.F. No. 2.2.8; 2.2.9) concluded that high mercury concentrations were localized and dependent on tidal cycles for mobilization from sediment to the overlying Howe Sound waters.

Analysis of sediment core samples from Mamquam Channel (O.D.C.A.R.F. No. 2.2.14) showed that volatile organic content and mercury levels in this area were low.

The migration of mercury and cadmium from marine sediments from upper Howe Sound was observed in a laboratory study to establish analytical procedure in 1979 (O.D.C.A.R.F. 5.2.3).

For additional information on the Squamish estuary readers are referred to the Report of the Estuary Working Group, Special Estuary Series No. 2 (Hoos and Vold, 1975).

#### **MONITORING INFORMATION:**

Benthic sediment surveys were conducted in July 1980 and March 1982 (Figure 16).

Trace metal concentrations of cadmium, lead, copper and zinc in core samples were higher in subsurface layers. This phenomenon may in part be attributed to the historic discharges from the Britannia Mine. Mercury levels, long a concern in the Squamish Estuary, were not elevated at the dumpsite (Tables 14 and 15).

Further benthic sediment and biological monitoring is planned for 1987.

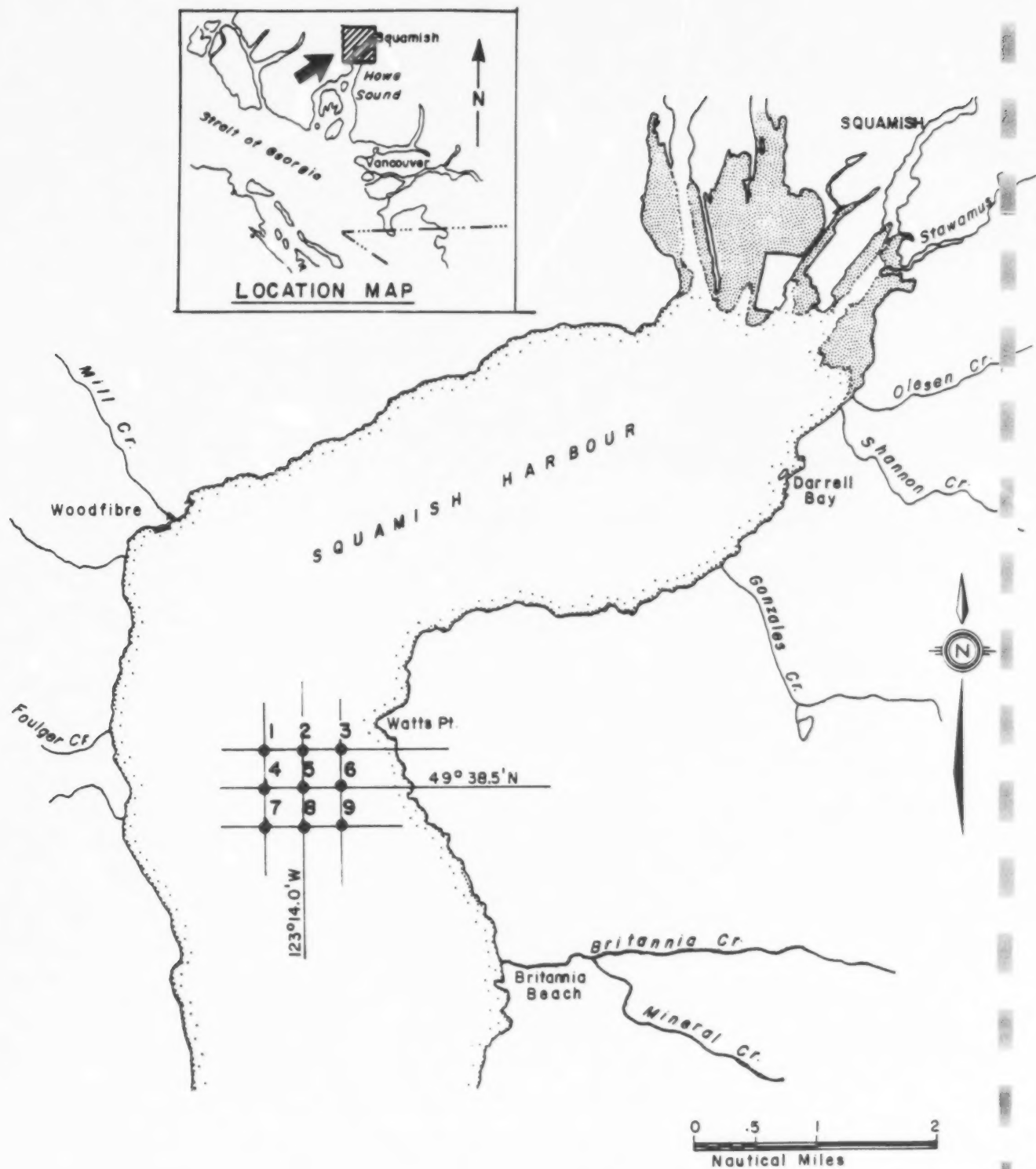


FIGURE 16 WATTS POINT OCEAN DUMPSITE - BENTHIC  
SEDIMENT SAMPLING STATIONS

**TABLE 14** WATTS POINT OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - CORE SAMPLES - JULY 1980

| STATION  | Hg           | Cd        | Pb    | Cu    | Zn    |
|----------|--------------|-----------|-------|-------|-------|
| 1        |              |           |       |       |       |
| 0-10 cm  | 0.406        | 0.56      | 66.0  | 189.0 | 124.0 |
| 30-40 cm | N.D.(.114)** | 1.52      | 156.0 | 391.0 | 416.0 |
| 60-70 cm | N.D.(.133)   | 0.67      | 103.0 | 395.0 | 195.0 |
| 2        |              |           |       |       |       |
| 0-10 cm  | 0.327        | N.D.(.55) | 65.0  | 195.0 | 134.0 |
| 30-40 cm | N.D.(.137)   | 1.15      | 81.5  | 315.0 | 247.0 |
| 60-70 cm | N.D.(.135)   | 0.95      | 72.0  | 198.0 | 194.0 |
| 3        |              |           |       |       |       |
| 0-10 cm  | 0.219        | 0.66      | 71.5  | 325.0 | 155.0 |
| 30-40 cm | N.D.(.127)   | 4.60      | 243.0 | 580.0 | 885.0 |
| 4        |              |           |       |       |       |
| 0-10 cm  | 0.331        | 0.56      | 76.5  | 221.0 | 145.0 |
| 30-40 cm | N.D.(.118)   | 1.91      | 130.0 | 483.0 | 394.0 |
| 60-70 cm | N.D.(.133)   | 0.85      | 63.5  | 99.5  | 139.0 |
| 5        |              |           |       |       |       |
| 0-10 cm  | 0.311        | 0.56      | 70.0  | 227.0 | 154.0 |
| 30-40 cm | N.D.(.133)   | 1.68      | 113.0 | 444.0 | 325.0 |
| 60-70 cm | N.D.(.114)   | 1.26      | 86.0  | 201.0 | 232.0 |
| 6        |              |           |       |       |       |
| 0-10 cm  | 0.296        | 0.78      | 67.0  | 259.0 | 172.0 |
| 30-40 cm | N.D.(.133)   | 4.35      | 263.0 | 605.0 | 855.0 |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

TABLE 14 (Continued)

| STATION  | Hg          | Cd   | Pb    | Cu    | Zn     |
|----------|-------------|------|-------|-------|--------|
| 7        |             |      |       |       |        |
| 0-10 cm  | 0.482       | 1.27 | 84.0  | 352.0 | 297.0  |
| 30-40 cm | N.D. (.132) | 1.72 | 162.0 | 683.0 | 429.0  |
| 8        |             |      |       |       |        |
| 0-10 cm  | 0.281       | 0.94 | 79.0  | 325.0 | 218.0  |
| 30-40 cm | 0.204       | 3.16 | 163.0 | 580.0 | 630.0  |
| 60-70 cm | N.D. (.135) | 2.51 | 177.0 | 720.0 | 560.0  |
| 9        |             |      |       |       |        |
| 0-10 cm  | N.D. (.133) | 0.94 | 81.0  | 439.0 | 227.0  |
| 30-40 cm | N.D. (.131) | 5.01 | 254.0 | 675.0 | 1010.0 |
| 60-70 cm | N.D. (.122) | 3.24 | 143.0 | 703.0 | 625.0  |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

**TABLE 15** WATTS POINT OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - CORE SAMPLES - MARCH 1982

| STATION | Hg   | Cd          | Pb  | Cu  | Zn  |
|---------|------|-------------|-----|-----|-----|
| 1       |      |             |     |     |     |
| 0-10    | 0.29 | N.D. (.2)** | 13  | 133 | 101 |
| 30-40   | 0.25 | 2.0         | 131 | 474 | 522 |
| 60-67   | 0.32 | 0.5         | 26  | 149 | 142 |
| 2       |      |             |     |     |     |
| 0-10    | 0.56 | 0.4         | 16  | 209 | 131 |
| 30-40   | 0.21 | 3.0         | 178 | 517 | 718 |
| 55-60   | 0.21 | 1.1         | 50  | 431 | 311 |
| 3       |      |             |     |     |     |
| 0-10    | 0.42 | N.D. (.2)   | 16  | 206 | 124 |
| 30-40   | 0.31 | 2.4         | 68  | 375 | 549 |
| 60-65   | 0.27 | 1.7         | 60  | 382 | 379 |
| 4       |      |             |     |     |     |
| 0-10    | 0.49 | N.D. (.2)   | 17  | 188 | 122 |
| 30-40   | 0.15 | 2.5         | 173 | 501 | 662 |
| 60-65   | 0.31 | 1.2         | 95  | 615 | 372 |
| 5       |      |             |     |     |     |
| 0-10    | 0.76 | 0.8         | 26  | 337 | 222 |
| 30-40   | 0.42 | 3.0         | 131 | 581 | 680 |
| 60-70   | 0.32 | 1.4         | 108 | 702 | 407 |
| 6       |      |             |     |     |     |
| 0-10    | 0.67 | 0.6         | 21  | 307 | 189 |
| 30-40   | 0.32 | 3.6         | 133 | 507 | 765 |
| 60-66   | 0.30 | 0.5         | 15  | 124 | 132 |
| 7       |      |             |     |     |     |
| 0-10    | 0.57 | 0.4         | 18  | 209 | 156 |
| 30-40   | 0.41 | 3.7         | 235 | 648 | 899 |
| 60-70   | 0.28 | 1.4         | 94  | 600 | 354 |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

TABLE 15 (Continued)

| STATION | Hg   | Cd  | Pb  | Cu  | Zn   |
|---------|------|-----|-----|-----|------|
| 8       |      |     |     |     |      |
| 0-10    | 1.08 | 1.2 | 34  | 404 | 293  |
| 30-40   | 0.39 | 3.4 | 199 | 583 | 792  |
| 60-70   | 0.32 | 2.5 | 141 | 852 | 609  |
| 9       |      |     |     |     |      |
| 0-10    | 0.40 | 0.4 | 18  | 206 | 128  |
| 10-20   | 1.36 | 2.7 | 48  | 589 | 544  |
| 20-30   | 0.40 | 3.2 | 56  | 484 | 647  |
| 30-40   | 0.44 | 4.1 | 126 | 540 | 825  |
| 40-50   | 0.38 | 4.8 | 221 | 627 | 1020 |
| 50-60   | 0.47 | 3.4 | 123 | 580 | 708  |
| 60-67   | 0.32 | 1.7 | 72  | 511 | 370  |

\* All results expressed in ug/g dry weight



DUMPSITE: NORTH PACIFIC OCEAN  
NUMBER: 107  
CO-ORDINATES: 48°25.00'N 126°20.00'W  
DEPTH: 1 000 metres  
TOTAL QUANTITY  
DUMPED: 125 995 cubic metres  
COMMENTS:

Site created for disposal of contaminated materials unsuited for landfill. Use infrequent.

**LOADSITE INFORMATION:**

The North Pacific Ocean Dumpsite (NPODS) has been used on two occasions for the disposal of material known to be contaminated. In 1976, Canadian Marine Drilling Ltd. were granted a Permit (O.D.C.A. file no. -00055) to dispose of 'Baroid' ballast from a drill ship being re-fitted in Esquimalt Harbour. The Baroid was composed mainly of barium sulphate and a fluid fraction containing pentachlorophenol (approximately 50 ppm) and formaldehyde. Approximately 1 000 tons, or 2 500 barrels of this material was discharged by pipe from a moving vessel after first mixing with sea water.

In the spring of 1984, British Columbia Place Limited were granted a Permit (O.D.C.A. file no. -01530) to dispose of contaminated marine sediments from False Creek. Approximately 125,000 cubic metres of surface sediments containing elevated levels of various contaminants, including cadmium and mercury, were dumped at NPODS by bottom dump scows.

Approval for dumping contaminated materials at NPODS was based on the assumption that the physical processes at the deep ocean site would ensure that the material would be 'rapidly rendered harmless.' Inspectors were present during all phases of the Baroid dumping to ensure that mixing and initial dispersion were effective. Disposal of False Creek sediments was conditional on completion of a monitoring program which included pre-

and post-dump turbidity measurements and bottom sediment sampling as well as visual tracking of the surface turbidity plume. The only fisheries concern in the area was for a mobile albacore tuna fishery which is very limited in its extent and duration (July to September). There was no timing restriction imposed on dumping at the site.

**RESEARCH INFORMATION:**

No research information available.

**MONITORING INFORMATION:**

Benthic sediment surveys were conducted in September 1983, April and August 1984 and July 1985 (Figure 17).

Although the procedure for cadmium testing at the time prior to the disposal of 'contaminated' False Creek sediments was not as accurate as current methods, trace metal concentrations do not appear to have been impacted at this dumpsite (Tables 16, 17, 18 and 19).

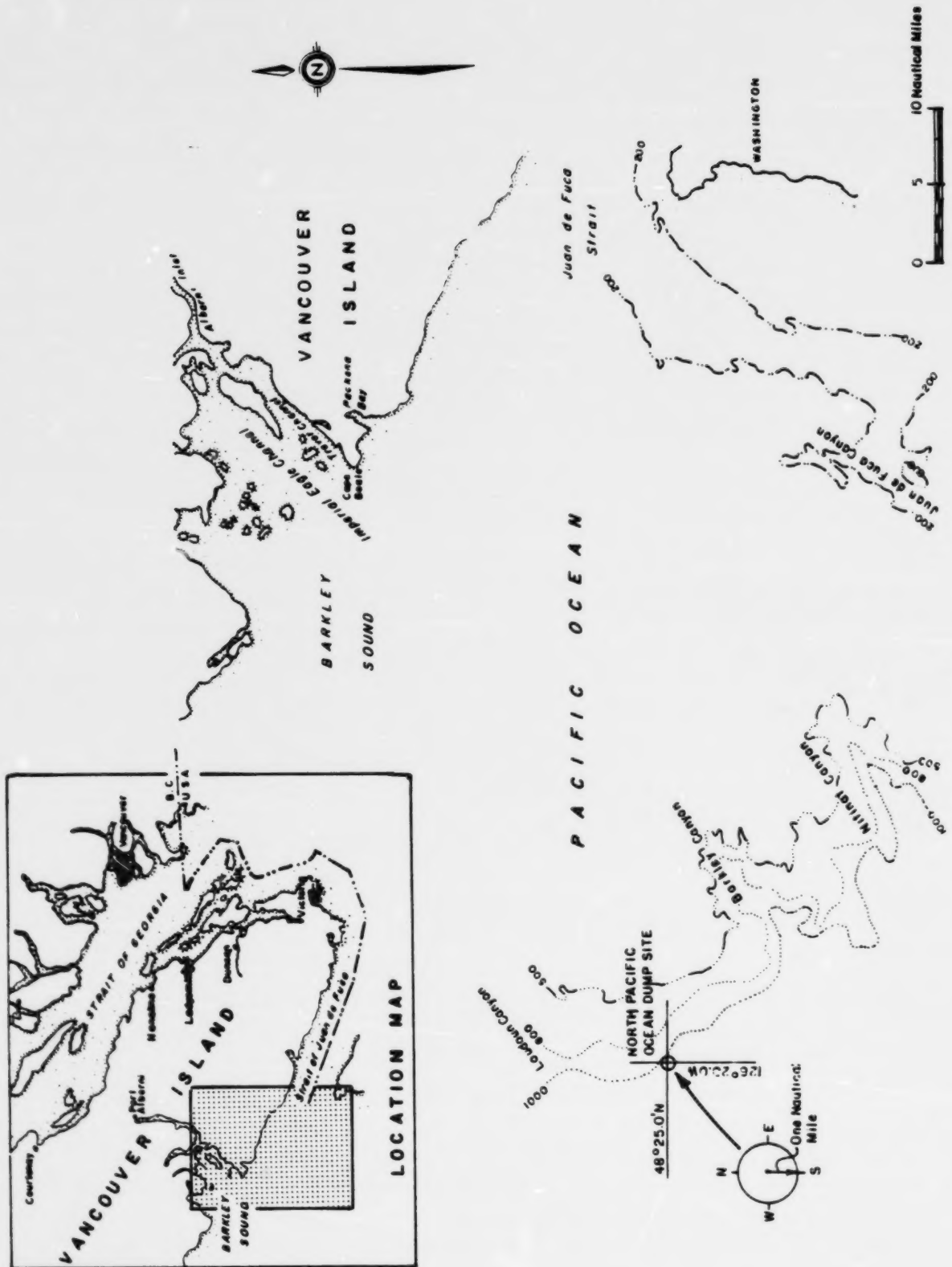


**FIGURE 17 NORTH PACIFIC OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS**

**TABLE 16** NORTH PACIFIC OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\* IN BENTHIC SEDIMENTS - GRAB SAMPLES - SEPTEMBER 1983

| STATION   |   | Hg        | Cd        | Pb        | Cu       | Zn     |
|-----------|---|-----------|-----------|-----------|----------|--------|
| Centre    | a | 0.09      | 0.9       | 7.        | 35.8     | 103    |
|           | b | 0.08      | 0.8       | 5.        | 39.7     | 112    |
|           | c | 0.09      | 1.1       | 6.        | 36.9     | 106    |
| East      | a | 0.10      | 1.0       | 6.        | 35.2     | 98.0   |
|           | b | 0.10      | 0.5       | 4.        | 34.8     | 99.8   |
|           | c | 0.10      | 0.6       | N.D.(3)** | 34.5     | 98.8   |
| South     | a | 0.07      | 0.8       | 8.        | 43.4     | 113    |
|           | b | 0.08      | 0.7       | 9.        | 44.8     | 115    |
|           | c | 0.08      | 0.7       | 10.       | 44.6     | 113    |
| West      | a | 0.08      | 0.9       | 9.        | 44.2     | 115    |
|           | b | 0.07      | 0.7       | 11.       | 44.8     | 117    |
|           | c | 0.14      | 0.6       | 10.       | 42.5     | 113    |
| North     | a | 0.08      | 0.7       | 7.        | 36.4     | 98.4   |
|           | b | 0.07      | 1.0       | 7.        | 35.8     | 98.0   |
|           | c | 0.07      | 0.6       | 10.       | 35.8     | 98.1   |
| MESS-1    |   |           |           |           |          |        |
| Certified |   | 0.17±0.01 | 0.59±0.10 | 34.0±6.1  | 25.1±3.8 | 191±17 |
| Found     |   | 0.17      | 0.6       | 27.       | 23.7     | 177    |
|           |   |           | 0.7       | 25.       | 21.7     | 170    |
|           |   |           | 0.7       | 26.       | 21.5     | 168    |
| BCSS-1    |   |           |           |           |          |        |
| Certified |   | 0.13±0.01 | 0.25±0.04 | 22.7±3.4  | 18.5±2.7 | 119±12 |
| Found     |   | 0.14      | 0.4       | 18.       | 15.4     | 106    |
|           |   |           | N.D.(.3)  | 17.       | 15.4     | 106    |
|           |   |           | 0.4       | 17.       | 14.1     | 100    |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

**TABLE 17** NORTH PACIFIC OCEAN DUMPSITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - CENTRE STATION - GRAB SAMPLES - APRIL 1984

| SAMPLE                                                     | Hg        | Cd         | Pb       | Cu       | Zn     |
|------------------------------------------------------------|-----------|------------|----------|----------|--------|
| green/grey<br>natural sediment                             | 0.177     | N.D.(.3)** | N.D.(3)  | 42.1     | 114.0  |
| grey/clay/sand<br>from dumping                             | 0.108     | 0.3        | 7.0      | 43.1     | 83.5   |
| mixture of above<br>plus black<br>sediment from<br>dumping | 0.190     | 0.5        | 18.0     | 48.1     | 120.0  |
| MESS-1                                                     |           |            |          |          |        |
| Certified                                                  | 0.17+0.01 | 0.59+0.1   | 34.0+6.1 | 25.1+3.8 | 191+17 |
| Found                                                      | 0.178     | 0.5        | 28       | 23.7     | 195    |
|                                                            | 0.189     | 0.5        | 29       | 23.6     | 198    |
|                                                            | 0.177     | 0.4        | 31       | 24.6     | 187    |
| BCSS-1                                                     |           |            |          |          |        |
| Certified                                                  | 0.13+0.01 | 0.25+0.04  | 22.7+3.4 | 18.5+2.7 | 119+12 |
| Found                                                      | 0.134     | N.D.(.3)   | 19       | 16.5     | 119    |
|                                                            | 0.123     | N.D.(.3)   | 18       | 16.3     | 114    |
|                                                            | 0.123     | N.D.(.3)   | 20       | 16.5     | 115    |

\* All results expressed in ug/g dry weight

\*\* Numbers in brackets are limits of detection

**TABLE 18 NORTH PACIFIC OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB SAMPLES - AUGUST 1984**

| STATION   | Hg                | Cd              | Pb             | Cu             | Zn           |
|-----------|-------------------|-----------------|----------------|----------------|--------------|
| C         | 0.134             | 0.20            | 5              | 41.1           | 113          |
|           | 0.105             | 0.25            | N.D.(3)**      | 39.5           | 111          |
|           | 0.123             | 0.22            | N.D.(3)        | 42.8           | 122          |
|           | $0.121 \pm 0.015$ | $0.22 \pm 0.02$ | -              | $41.1 \pm 1.6$ | $115 \pm 6$  |
|           |                   |                 |                |                |              |
| E         | 0.187             | 0.29            | 5              | 48.7           | 128          |
|           | 0.145             | 0.36            | 4              | 50.9           | 125          |
|           | 0.124             | 0.38            | 3              | 47.6           | 126          |
|           | $0.152 \pm 0.032$ | $0.34 \pm 0.05$ | $4 \pm 1$      | $49.1 \pm 1.7$ | $126 \pm 2$  |
|           |                   |                 |                |                |              |
| MESS-1    |                   |                 |                |                |              |
| Certified | $0.171 \pm 0.014$ | $0.59 \pm 0.10$ | $34 \pm 6.1$   | $25.1 \pm 3.8$ | $191 \pm 17$ |
| Found     | 0.205             | 0.59            | 25             | 21.9           | 175          |
|           | 0.195             | 0.61            | 26             | 24.4           | 185          |
|           | -                 | 0.64            | 28             | 23.2           | 195          |
|           | -                 | -               | 29             | 25.0           | 191          |
|           | -                 | -               | 26             | 22.3           | 178          |
|           | -                 | -               | 27             | 24.7           | 188          |
| BCSS-1    |                   |                 |                |                |              |
| Certified | $0.129 \pm 0.12$  | $0.25 \pm 0.04$ | $22.7 \pm 3.4$ | $18.5 \pm 2.7$ | $119 \pm 12$ |
| Found     | 0.153             | 0.28            | 12             | 15.2           | 111          |
|           | 0.147             | 0.31            | 17             | 16.5           | 116          |
|           | -                 | 0.28            | 15             | 16.2           | 114          |
|           | -                 | -               | 13             | 14.6           | 108          |
|           | -                 | -               | 15             | 15.8           | 110          |
|           |                   |                 |                |                |              |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

**TABLE 19** NORTH PACIFIC OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB SAMPLES - JULY 1985

| STATION   | Hg              | Cd              | Pb         | Cu             | Zn           |
|-----------|-----------------|-----------------|------------|----------------|--------------|
| CENTRE    | 0.14            | 0.30            | 6          | 44.7           | 108          |
|           | 0.15            | 0.36            | 8          | 44.3           | 120          |
|           | 0.14            | 0.28            | N.D.(3)    | 35.7           | 100          |
|           | $0.14 \pm 0.01$ | $0.31 \pm 0.04$ |            | $41.6 \pm 5.1$ | $109 \pm 10$ |
| EAST      | 0.10            | 0.17            | 5          | 35.7           | 108          |
|           | 0.13            | 0.22            | N.D.(3)    | 38.0           | 114          |
|           | 0.10            | 0.22            | 4          | 35.8           | 109          |
|           | $0.11 \pm 0.02$ | $0.20 \pm 0.03$ |            | $36.8 \pm 1.2$ | $110 \pm 3$  |
| SOUTH     | 0.16            | 0.31            | N.D.(3)    | 49.4           | 125          |
|           | 0.19            | 0.26            | 4          | 50.6           | 125          |
|           | 0.18            | 0.22            | N.D.(3)    | 50.4           | 127          |
|           | $0.18 \pm 0.02$ | $0.26 \pm 0.05$ |            | $50.1 \pm 0.6$ | $126 \pm 1$  |
| WEST      | 0.15            | 0.47            | N.D.(3)    | 52.3           | 128          |
|           | 0.14            | 0.34            | N.D.(3)    | 47.1           | 121          |
|           | 0.16            | 0.42            | N.D.(3)    | 49.5           | 123          |
|           | $0.15 \pm 0.01$ | $0.41 \pm 0.07$ |            | $49.6 \pm 2.6$ | $124 \pm 4$  |
| NORTH     | 0.16            | 0.28            | 13         | 41.2           | 112          |
|           | 0.17            | 0.31            | 16         | 83.3           | 103          |
|           | 0.18            | 0.32            | 13         | 37.6           | 102          |
|           | $0.17 \pm 0.01$ | $0.30 \pm 0.02$ | $14 \pm 2$ | $54.0 \pm 25$  | $106 \pm 6$  |
| MESS-1    |                 |                 |            |                |              |
| Certified | $0.17 \pm 0.01$ | $0.59 \pm 0.10$ | $34 \pm 6$ | $25.1 \pm 3.8$ | $191 \pm 17$ |
| Found     | 0.22            | 0.52            | 26         | 23.3           | 183          |
|           | 0.24            | 0.55            | 30         | 23.9           | 185          |
|           | 0.23            | 0.52            | 26         | 23.2           | 180          |
| BCSS-1    |                 |                 |            |                |              |
| Certified | $0.13 \pm 0.01$ | $0.24 \pm 0.04$ | $23 \pm 3$ | $18.5 \pm 2.7$ | $119 \pm 12$ |
| Found     | 0.16            | 0.27            | 15         | 14.3           | 104          |
|           | 0.18            | 0.26            | 13         | 14.3           | 109          |
|           | 0.18            | 0.26            | 15         | 14.2           | 105          |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection



DUMPSITE: VANCOUVER HARBOUR - INCINERATOR  
NUMBER: 112  
CO-ORDINATES: 49°17.20'N 123°05.80'W  
DEPTH: 1 metre  
TOTAL QUANTITY  
DUMPED: 5 900 cubic metres  
LOADSITE INFORMATION:

The disposal of wastes at sea by incineration or thermal degradation requires a permit under the O.D.C.A. Aqua Clean Ships Ltd. have operated an incinerator on a barge moored in Vancouver Harbour since 1981 to dispose of ship galley wastes. The wastes, comprised mainly of paper products and food scraps, are collected from various freighters and cruise ships anchored in the harbour. To ensure clean and complete incineration the material burned must contain no more than 5% oily engine room rags and no more than 20% galley food wastes. The ash remaining after incineration is disposed of at an approved landfill site.

**RESEARCH INFORMATION:**

No research information available.

DUMPSITE: GABRIOLA  
NUMBER: 113  
CO-ORDINATES: 49°08.00'N 123°32.00'W  
DEPTH: 360 metres.  
TOTAL QUANTITY  
DUMPED: 70 tonnes  
COMMENTS:

Site created for the disposal of derelict vessels/platforms.

**LOADSITE INFORMATION:**

The Gabriola dump site was established in 1986 for the sinking of derelict vessels/platforms. The Ballenas Basin dump site (No. 115) had also been proposed for this purpose; however, it was felt that it may be hazardous to tow derelict vessels, most of which are located in the lower mainland area, the considerable distance to the dump site. The Gabriola site was therefore selected owing to its closer proximity to loadsites i.e.; approximately 30 kilometres from Vancouver. This site has been used on one occasion to sink an old fishing vessel (O.D.C.A. file no. - 01982). All chemical substances and any fuel, oil, grease or other hydrocarbons must be removed from vessels prior to sinking.

**RESEARCH INFORMATION:**

No research information available.

**MONITORING INFORMATION:**

A benthic sediment survey was conducted in April 1986 to establish background baseline data for the dumpsite designated in March 1986 (Figure 18).

Trace metal concentrations are not of concern at this location, (Table 20).

To date, the site has been used for the disposal of the vessel B.C.P.

44. Further benthic sediment surveys are planned for 1987.

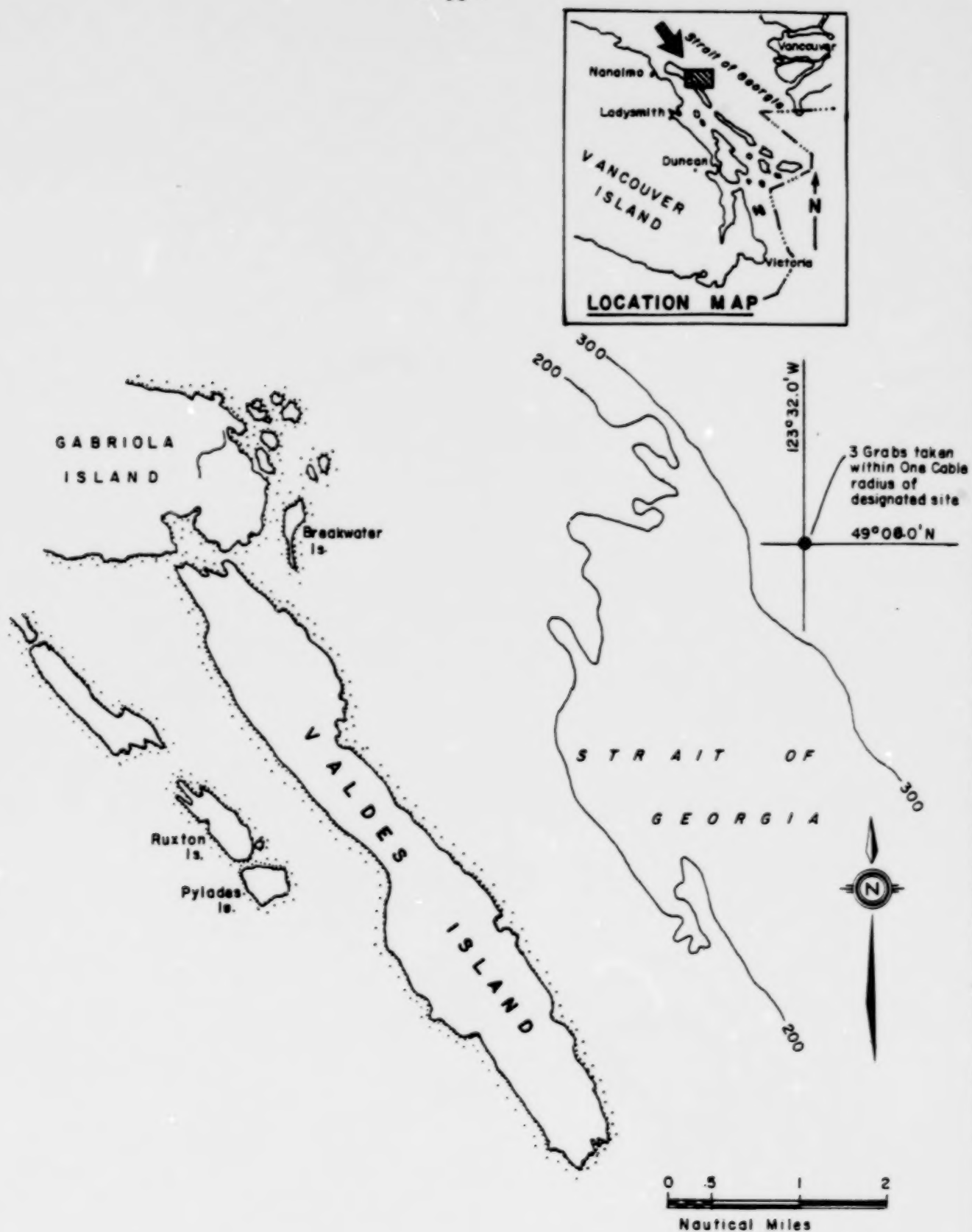


FIGURE 18 GABRIOLA DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

**TABLE 20** GABRIOLA OCEAN DUMP SITE TRACE METAL CONCENTRATIONS\* IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION STANDARD DEVIATION - GRAB SAMPLES - APRIL 1986

| STATION   | Hg                                           | Cd                                      | Pb                             | Cu                                     | Zn                               |
|-----------|----------------------------------------------|-----------------------------------------|--------------------------------|----------------------------------------|----------------------------------|
| 1         | 0.208<br>0.185<br>0.136<br>$0.176 \pm 0.137$ | 0.26<br>0.27<br>0.26<br>$0.26 \pm 0.01$ | 21<br>24<br>21<br>$22 \pm 1.7$ | 46.3<br>47.9<br>49.2<br>$47.8 \pm 1.5$ | 115<br>120<br>122<br>$119 \pm 4$ |
| 2         | 0.144<br>0.126<br>0.145<br>$0.138 \pm 0.01$  | 0.32<br>0.23<br>0.25<br>$0.27 \pm 0.05$ | 19<br>25<br>22<br>$22 \pm 3$   | 45.3<br>45.6<br>50.5<br>$47.1 \pm 2.9$ | 114<br>114<br>121<br>$116 \pm 4$ |
| 3         | 0.132<br>0.176<br>0.170<br>$0.159 \pm 0.02$  | 0.25<br>0.28<br>0.30<br>$0.28 \pm 0.03$ | 26<br>31<br>27<br>$28 \pm 2.7$ | 53.2<br>53.8<br>52.4<br>$53.1 \pm 0.7$ | 124<br>126<br>130<br>$127 \pm 3$ |
| MESS-1    |                                              |                                         |                                |                                        |                                  |
| Certified | $0.17 \pm 0.01$                              | $0.59 \pm 0.10$                         | $34.0 \pm 6.1$                 | $25.1 \pm 3.8$                         | $191 \pm 17$                     |
| Found     | 0.21<br>0.18<br>0.19<br>0.20<br>0.18         | 0.45<br>0.46<br>0.46<br>0.55<br>0.47    | 31<br>29<br>30<br>31<br>30     | 23.7<br>22.7<br>21.9<br>22.4<br>22.6   | 176<br>156<br>157<br>175<br>169  |
| BCSS-1    |                                              |                                         |                                |                                        |                                  |
| Certified | $0.13 \pm 0.01$                              | $0.25 \pm 0.04$                         | $22.7 \pm 3.4$                 | $18.5 \pm 2.7$                         | $119 \pm 12$                     |
| Found     | 0.15<br>0.13<br>0.14<br>0.13<br>0.15         | 0.29<br>0.33<br>0.30<br>0.30<br>0.39    | 25<br>28<br>24<br>25<br>27     | 16.5<br>16.5<br>14.9<br>15.7<br>14.5   | 101<br>103<br>97<br>100<br>95    |

\* All results expressed in ug/g dry weight

DUMPSITE: THORMANBY ISLAND  
NUMBER: 114  
CO-ORDINATES: 49°27.50'N 124°04.50'W  
DEPTH: 384 metres  
TOTAL QUANTITY  
DUMPED: 5 400 cubic metres  
LOADSITE INFORMATION:

The Thormanby Island dump site was designated in 1980 to accommodate the disposal of a small volume of clean natural sediments from two projects in the area. Approximately 4 000 cubic metres from a small bay on Lasqueti Island and 1 000 cubic metres from Secret Cove, Sechelt Peninsula, were dumped in 1980/81. In 1981, 500 cubic metres of clean natural sediments originating in Halfmoon Bay, Sechelt Peninsula, were dumped at the site (O.D.C.A. file no. -01189). This is the last time the site has been used to date.

The Department of Fisheries and Oceans have general concerns about the impact on oyster and clam beds and shellfish habitat at the loadsites. A commercial hake fishery exists in the vicinity of the dump site and salmon fry, larval cod and shrimp are abundant in the area from April to September. Dredging and dumping is therefore discouraged during this period.

**RESEARCH INFORMATION:**

No research information available.

**MONITORING INFORMATION:**

A benthic sediment survey was conducted in October 1984 (Figure 19). Expected background levels of trace metal concentrations for the Strait of Georgia were found (Table 21).

A Pisces IV dive was conducted at this site in December 1984 (Appendix II). The dive records indicate a bottom type similar to the Malaspina Strait dump site, without the wood debris and associated epifauna (Munida quadraspina, rockfish, Neptunea sp., etc.). The most abundant benthos was the small pink shrimp typical of soft flat bottoms in the Strait of Georgia.



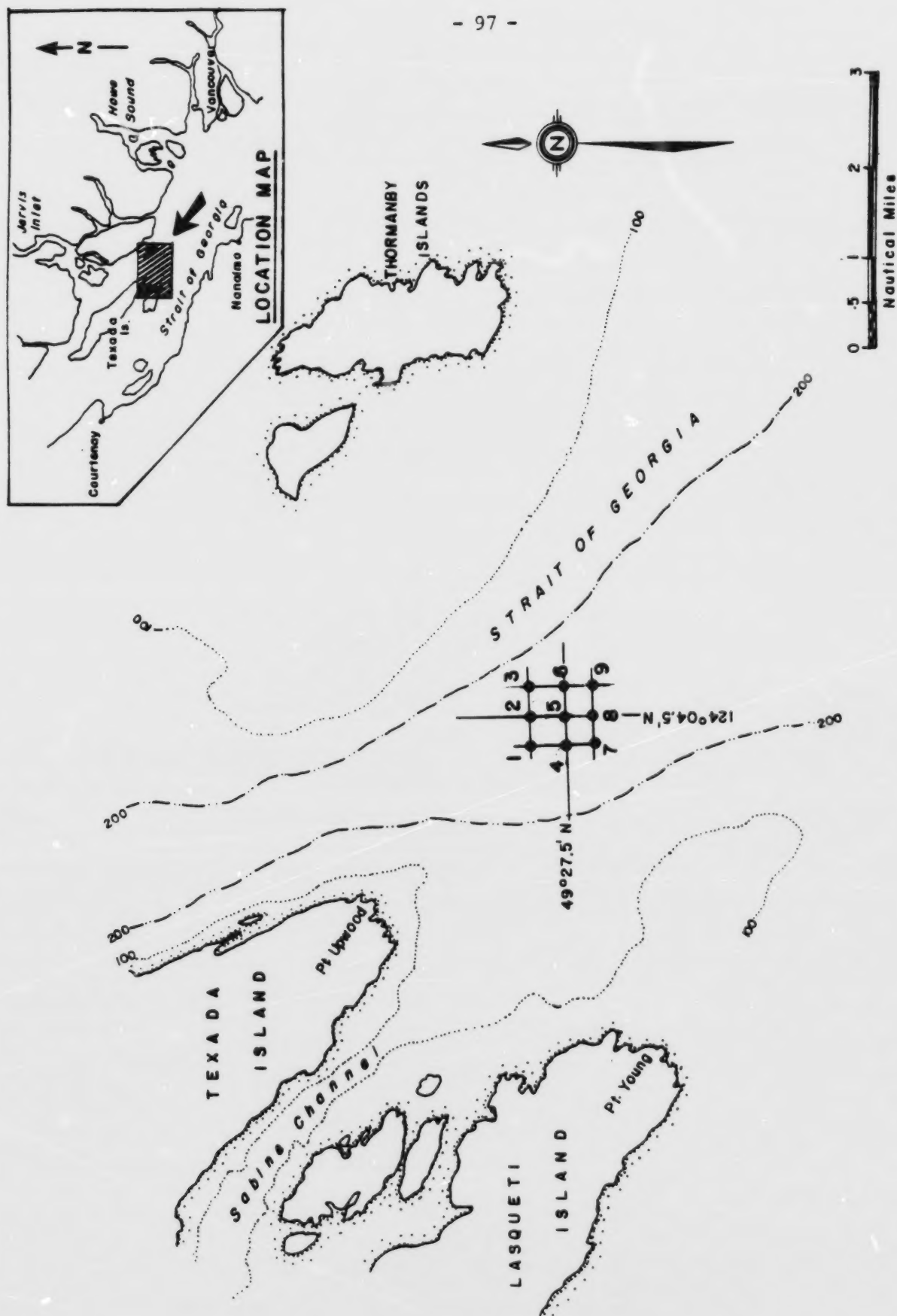


FIGURE 19 THORMANBY ISLAND OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

**TABLE 21 THORMANBY ISLAND OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\* IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION STANDARD DEVIATION - GRAB SAMPLES - OCTOBER 1984**

| STATION | Hg                                             | Cd                                             | Pb                                  | Cu                                  | Zn                                       |
|---------|------------------------------------------------|------------------------------------------------|-------------------------------------|-------------------------------------|------------------------------------------|
| T-1     | 0.18<br>0.18<br>0.18<br><u>0.18</u> $\pm$ 0    | 0.39<br>0.41<br>0.42<br><u>0.41</u> $\pm$ 0.02 | 40<br>41<br>40<br><u>40</u> $\pm$ 1 | 60<br>60<br>58<br><u>59</u> $\pm$ 1 | 152<br>155<br>156<br><u>154</u> $\pm$ 2  |
| T-2     | 0.18<br>0.16<br>0.18<br><u>0.17</u> $\pm$ .01  | 0.35<br>0.36<br>0.36<br><u>0.36</u> $\pm$ 0.01 | 41<br>43<br>42<br><u>42</u> $\pm$ 1 | 56<br>58<br>62<br><u>59</u> $\pm$ 3 | 147<br>142<br>156<br><u>148</u> $\pm$ 7  |
| T-3     | 0.22<br>0.20<br>0.18<br><u>0.20</u> $\pm$ 0.02 | 0.40<br>0.39<br>0.38<br><u>0.39</u> $\pm$ 0.01 | 40<br>40<br>41<br><u>40</u> $\pm$ 1 | 60<br>60<br>57<br><u>59</u> $\pm$ 2 | 156<br>156<br>155<br><u>156</u> $\pm$ 1  |
| T-4     | 0.18<br>0.19<br>0.17<br><u>0.18</u> $\pm$ 0.01 | 0.34<br>0.60<br>0.52<br><u>0.49</u> $\pm$ 0.13 | 42<br>40<br>41<br><u>41</u> $\pm$ 1 | 60<br>60<br>60<br><u>60</u> $\pm$ 0 | 142<br>153<br>161<br><u>152</u> $\pm$ 10 |
| T-5     | 0.18<br>0.15<br>0.19<br><u>0.17</u> $\pm$ 0.02 | 0.34<br>0.32<br>0.41<br><u>0.36</u> $\pm$ 0.05 | 39<br>36<br>41<br><u>39</u> $\pm$ 3 | 54<br>53<br>64<br><u>57</u> $\pm$ 6 | 139<br>132<br>155<br><u>142</u> $\pm$ 12 |
| T-6     | 0.17<br>0.18<br>0.21<br><u>0.19</u> $\pm$ 0.02 | 0.37<br>0.38<br>0.44<br><u>0.40</u> $\pm$ 0.04 | 41<br>43<br>50<br><u>45</u> $\pm$ 5 | 62<br>59<br>66<br><u>62</u> $\pm$ 4 | 158<br>150<br>162<br><u>157</u> $\pm$ 6  |
| T-7     | 0.09<br>0.18<br>0.18<br><u>0.15</u> $\pm$ 0.05 | 0.36<br>0.42<br>0.38<br><u>0.39</u> $\pm$ 0.03 | 43<br>44<br>40<br><u>42</u> $\pm$ 2 | 59<br>63<br>61<br><u>61</u> $\pm$ 2 | 152<br>166<br>154<br><u>157</u> $\pm$ 8  |

\* All results expressed in ug/g dry weight

TABLE 21 (Continued)

| STATION | Hg              | Cd              | Pb         | Cu         | Zn           |
|---------|-----------------|-----------------|------------|------------|--------------|
| T-8     | 0.16            | 0.32            | 40         | 54         | 139          |
|         | 0.17            | 0.34            | 39         | 55         | 141          |
|         | 0.18            | 0.42            | 41         | 59         | 149          |
|         | $0.17 \pm 0.01$ | $0.36 \pm 0.05$ | $40 \pm 1$ | $56 \pm 3$ | $143 \pm 5$  |
|         |                 |                 |            |            |              |
| T-9     | 0.19            | 0.46            | 43         | 64         | 158          |
|         | 0.18            | 0.66            | 45         | 65         | 163          |
|         | 0.18            | 0.39            | 46         | 65         | 160          |
|         | $0.18 \pm 0.01$ | $0.50 \pm 0.14$ | $45 \pm 2$ | $65 \pm 1$ | $160 \pm 3$  |
|         |                 |                 |            |            |              |
| MESS-1  |                 |                 |            |            |              |
| Cert.   | $0.17 \pm 0.01$ | $0.59 \pm 0.10$ | $34 \pm 6$ | $25 \pm 4$ | $191 \pm 17$ |
| Found   | 0.21            | 0.57            | 34         | 25         | 176          |
|         | 0.21            | 0.51            | 33         | 25         | 182          |
|         | 0.21            | 0.44            | 33         | 22         | 167          |
|         | 0.20            | 0.49            | 28         | 23         | 164          |
|         | 0.18            | 0.50            | 34         | 23         | 182          |
|         | 0.19            | 0.46            | 37         | 24         | 181          |
|         | 0.19            | 0.62            | 31         | 21         | 161          |
|         | 0.19            | 0.56            | 38         | 23         | 175          |
|         | 0.19            | 0.44            | 37         | 24         | 181          |
| BCSS-1  |                 |                 |            |            |              |
| Cert.   | $0.13 \pm 0.01$ | $0.24 \pm 0.04$ | $23 \pm 3$ | $18 \pm 3$ | $119 \pm 12$ |
| Found   | 0.23            | 0.51            | 32         | 23         | 170          |
|         | 0.13            | 0.21            | 16         | 12         | 82           |
|         | 0.18            | 0.26            | 22         | 15         | 99           |
|         | 0.15            | 0.28            | 30         | 18         | 111          |
|         | 0.15            | 0.38            | 24         | 16         | 105          |
|         | 0.13            | 0.26            | 26         | 15         | 100          |
|         | 0.14            | 0.25            | 26         | 15         | 98           |
|         | 0.15            | 0.29            | 25         | 17         | 108          |
|         | 0.15            | 0.26            | -          | -          | -            |

\* All results expressed in ug/g dry weight

DUMPSITE:               BALLENAS BASIN  
NUMBER:                115  
CO-ORDINATES:        49°23.50'N   123°58.00'W  
DEPTH:                400 metres  
TOTAL QUANTITY  
DUMPED:                Nil  
LOADSITE INFORMATION:

The Ballenas Basin dump site is located within an area of the Strait of Georgia just south of Texada Island known as the 'Disused Ammunition Dumping Area' of the Department of National Defense (D.N.D.). The site was designated in 1985 for a test dump of approximately 5 000 tonnes (2 500 cubic metres) of waste gypsum wallboard from Westroc Industries manufacturing plant in Vancouver. The material was end dumped from a scow while environmental consultants made visual observations and took transmissometer measurements of the resultant turbidity plume. The bulk of the material sank rapidly and the surface turbidity plume dissipated a very short distance from the scow. A small amount of floating wallboard paper was observed and noted to have eventually sunk.

Although there was no apparent environmental impact from the dumping operation, the Department of Fisheries and Oceans were concerned with the possible long term fate and effects on the sea bottom in the Strait of Georgia. It was felt that further dumping of this material at the Ballenas Basin site should not be approved, however, use of the North Pacific Ocean dump site remained an option (see discussion for O.D.C.A. file no. -01813 under dumpsite no. 107).

In 1986, D.N.D. approved a request from R.O.D.A.C. to use the Ballenas Basin site for the sinking of derelict vessels/platforms. To date the site has not been used for this purpose.

#### RESEARCH INFORMATION:

Environmental Protection ran 96 hour acute toxicity bioassays on gypsum waste samples in tanks of fresh water and salt water. The samples were non-toxic to rainbow trout and chum salmon, respectively, after the exposure period of 96 hours.

#### MONITORING INFORMATION:

Benthic sediment surveys were conducted in April 1984, November 1985 and April 1986 (Figures 20 and 21). The monitoring grid was expanded during the November 1985 survey.

In October 1985, an experiment was conducted to determine the distribution in the vicinity of the proposed dumpsite of crushed gypsum wallboard.

The concentration of scheduled metals were found to be within normal background levels for the Strait of Georgia (Tables 22, 23 and 24). Calcium was included in the tables as it is a major component of gypsum wall board.

A Pisces IV dive was completed in November 1983. The dive report (Appendix II) indicates a bottom typical of the Strait of Georgia; fine brown sediment overlying fine grey clay-like sediment. A sparse benthos was noted which included shrimp, burrowing anemones, eelpouts and sole.

To date, the site has only been used for the gypsum experiment and has been approved for the disposal of derelict vessels.

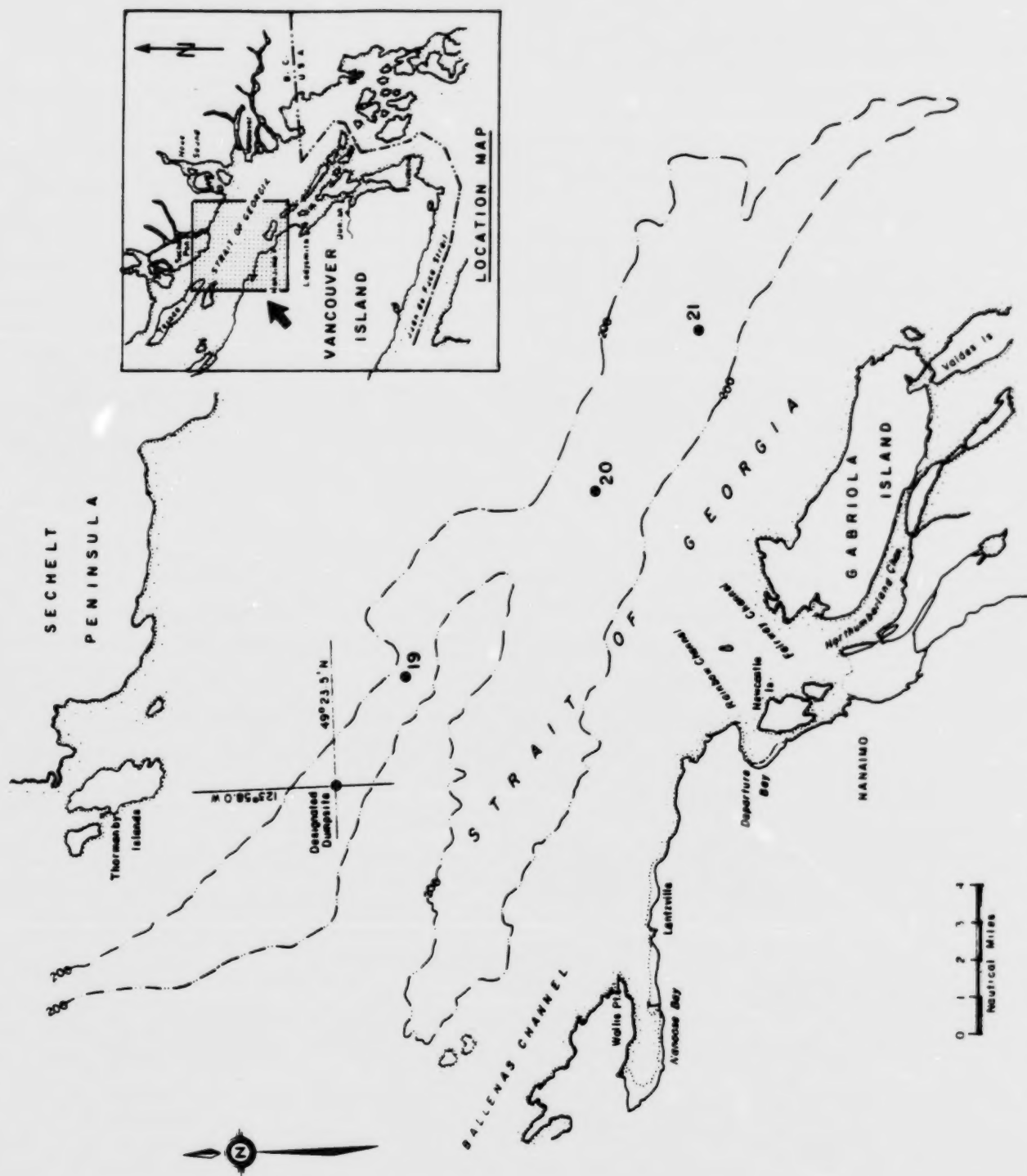


**TABLE 22**    **BALLENAS BASIN OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\***  
**IN BENTHIC SEDIMENTS - CORE SAMPLES - APRIL 1984**

| STATION    | Hg                | Cd              | Pb             | Cu               | Zn              |
|------------|-------------------|-----------------|----------------|------------------|-----------------|
| 19         |                   |                 |                |                  |                 |
| 0-10 cm    | 0.038             | N.D.(.3)**      | 8              | 45.5             | 118             |
| 30-40 cm   | 0.026             | 0.8             | 6              | 48.1             | 110             |
| 60-70 cm   | 0.026             | N.D.(.3)        | N.D.(3)        | 46.3             | 117             |
| 140-150 cm | 0.026             | 0.9             | 5              | 46.3             | 109             |
| 20         |                   |                 |                |                  |                 |
| 0-10 cm    | 0.051             | N.D.(.3)        | 15             | 53.6             | 137             |
| 30-40 cm   | 0.038             | N.D.(.3)        | 8              | 42.4             | 106             |
| 60-70 cm   | 0.032             | N.D.(.3)        | 6              | 38.6             | 105             |
| 150-170 cm | 0.032             | N.D.(.3)        | 8              | 38.4             | 106             |
| 21         |                   |                 |                |                  |                 |
| 0-10 cm    | 0.064             | N.D.(.3)        | 17             | 51.0             | 139             |
| 30-40 cm   | 0.045             | N.D.(.3)        | 16             | 49.4             | 120             |
| 60-70 cm   | 0.032             | N.D.(.3)        | 5              | 42.4             | 108             |
| 170-190 cm | 0.045             | N.D.(.3)        | 9              | 38.1             | 104             |
| MESS-1     |                   |                 |                |                  |                 |
| Certified  | 0.17 $\pm$ 0.01   | 0.59 $\pm$ 0.1  | 34.0 $\pm$ 6.1 | 25.1 $\pm$ 3.8   | 191 $\pm$ 17    |
| Found      | 0.178             | 0.5             | 28             | 23.7             | 195             |
|            | 0.189             | 0.5             | 29             | 23.6             | 198             |
|            | 0.177             | 0.4             | 31             | 24.6             | 187             |
|            | 0.181 $\pm$ 0.007 | 0.46 $\pm$ 0.06 | 29.3 $\pm$ 1.5 | 23.96 $\pm$ 0.55 | 193.3 $\pm$ 5.7 |
| BCSS-1     |                   |                 |                |                  |                 |
| Certified  | 0.13 $\pm$ 0.01   | 0.25 $\pm$ 0.04 | 22.7 $\pm$ 3.4 | 18.5 $\pm$ 2.7   | 119 $\pm$ 12    |
| Found      | 0.134             | N.D.(.3)        | 19             | 16.5             | 119             |
|            | 0.123             | N.D.(.3)        | 18             | 16.3             | 114             |
|            | 0.123             | N.D.(.3)        | 20             | 16.5             | 115             |
|            | 0.126 $\pm$ 0.006 |                 | 19.0 $\pm$ 1.0 | 16.4 $\pm$ 0.11  | 116 $\pm$ 2.6   |

\* All results expressed in ug/g dry weight

\*\* Numbers in brackets are limits of detection



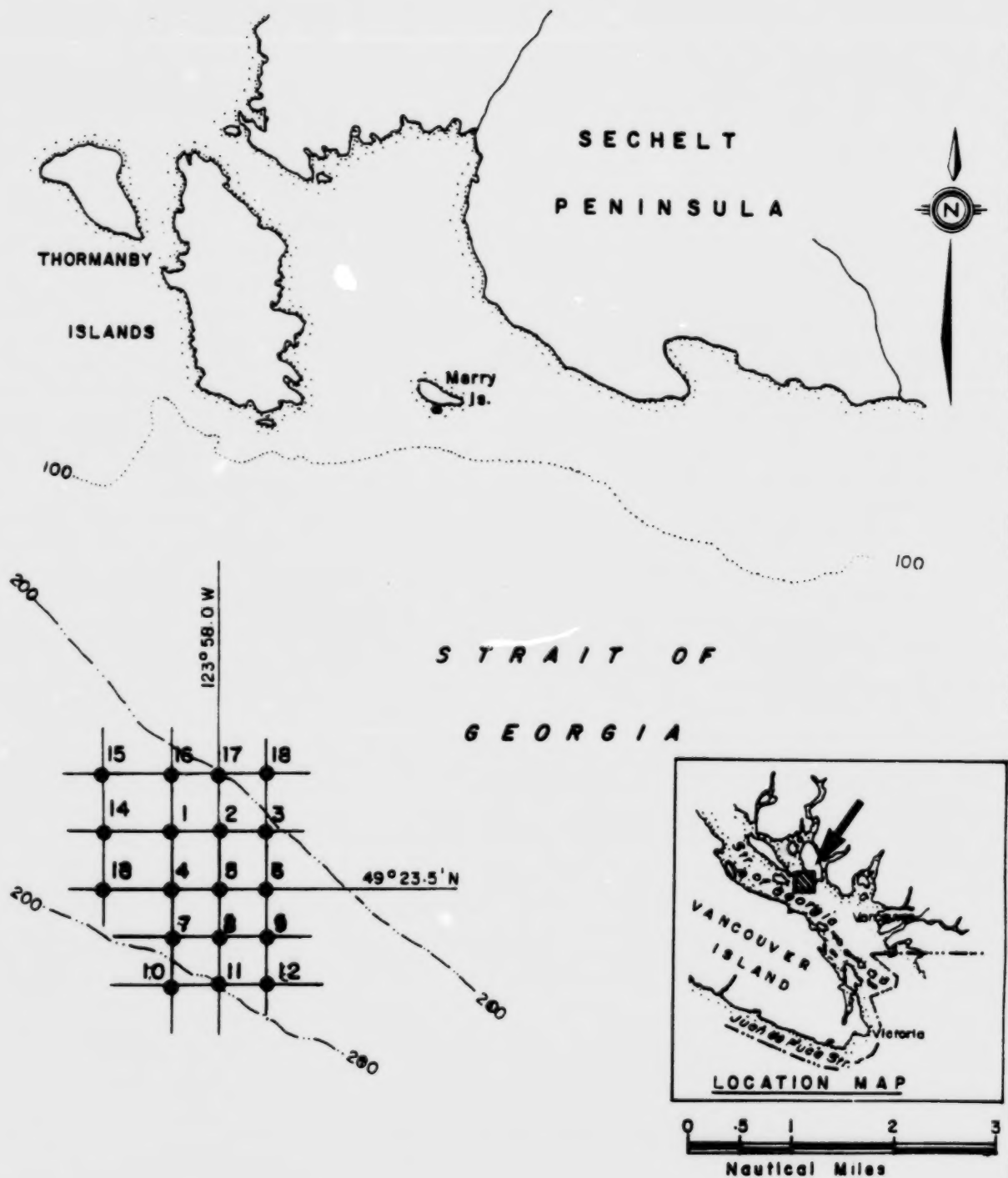


FIGURE 21 BALLENAS BASIN OCEAN DUMPSITE - BENTHIC  
SEDIMENT SAMPLING STATIONS

**TABLE 23** BALLENAS BASIN OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB AND CORE SAMPLES - NOVEMBER 1985

| STATION    | Hg                                           | Cd                                           | Pb                                 | Cu                                           | Zn                                     | Ca<br>(x 1,000)                               |
|------------|----------------------------------------------|----------------------------------------------|------------------------------------|----------------------------------------------|----------------------------------------|-----------------------------------------------|
| 4          | 0.37<br>0.39<br>0.30<br>0.35 <sub>±.05</sub> | 0.41<br>0.41<br>0.47<br>0.43 <sub>±.03</sub> | 24<br>27<br>25<br>25 <sub>±2</sub> | 68.4<br>68.4<br>68.0<br>68.3 <sub>±.2</sub>  | 164<br>161<br>166<br>164 <sub>±3</sub> | 8.57<br>10.00<br>8.66<br>9.08 <sub>±.80</sub> |
| 5          | 0.38<br>0.36<br>0.28<br>0.34 <sub>±.05</sub> | 0.36<br>0.36<br>0.31<br>0.34 <sub>±.03</sub> | 18<br>22<br>24<br>21 <sub>±3</sub> | 59.2<br>64.8<br>66.2<br>63.4 <sub>±3.7</sub> | 157<br>162<br>163<br>161 <sub>±3</sub> | 8.41<br>8.41<br>8.38<br>8.40 <sub>±.02</sub>  |
| 6          | 0.36<br>0.26<br>0.30<br>0.31 <sub>±.05</sub> | 0.52<br>1.58<br>0.90<br>1.00 <sub>±.54</sub> | 23<br>18<br>20<br>20 <sub>±3</sub> | 65.1<br>68.0<br>64.9<br>66.0 <sub>±1.7</sub> | 160<br>164<br>163<br>162 <sub>±2</sub> | 13.1<br>9.1<br>13.1<br>11.8 <sub>±2.3</sub>   |
| 7          | 0.25<br>0.31<br>0.28<br>0.28 <sub>±.03</sub> | 0.38<br>0.33<br>0.48<br>0.40 <sub>±.08</sub> | 22<br>22<br>26<br>23 <sub>±2</sub> | 65.8<br>65.5<br>69.5<br>66.9 <sub>±2.2</sub> | 172<br>171<br>179<br>174 <sub>±4</sub> | 10.5<br>8.69<br>8.61<br>9.27 <sub>±1.07</sub> |
| 8          | 0.34<br>0.47<br>0.38<br>0.40 <sub>±.07</sub> | 0.35<br>0.36<br>0.61<br>0.44 <sub>±.20</sub> | 24<br>24<br>25<br>24 <sub>±1</sub> | 65.2<br>69.6<br>63.4<br>66.1 <sub>±3.2</sub> | 162<br>166<br>168<br>165 <sub>±3</sub> | 8.31<br>8.11<br>8.59<br>8.34 <sub>±.24</sub>  |
| 8          |                                              |                                              |                                    |                                              |                                        |                                               |
| 0-10 cm    | 0.29                                         | 0.38                                         | 18                                 | 64.8                                         | 171                                    | 8.70                                          |
| 10-20 cm   | 0.36                                         | 0.86                                         | 12                                 | 63.4                                         | 147                                    | 8.47                                          |
| 20-30 cm   | 0.30                                         | 0.56                                         | 12                                 | 60.0                                         | 125                                    | 8.58                                          |
| 30-40 cm   | 0.34                                         | 1.56                                         | 6                                  | 52.2                                         | 117                                    | 8.13                                          |
| 60-70 cm   | 0.22                                         | 0.63                                         | N.D.(3)**                          | 49.3                                         | 117                                    | 8.40                                          |
| 90-100 cm  | 0.27                                         | 0.57                                         | N.D.(3)                            | 48.8                                         | 117                                    | 8.60                                          |
| 170-180 cm | 0.17                                         | 0.65                                         | N.D.(3)                            | 46.9                                         | 115                                    | 8.45                                          |
| 9          | 0.33<br>0.31<br>0.36<br>0.33 <sub>±.03</sub> | 0.32<br>0.35<br>0.36<br>0.34 <sub>±.02</sub> | 21<br>19<br>27<br>22 <sub>±4</sub> | 60.6<br>61.5<br>66.2<br>62.8 <sub>±3.0</sub> | 155<br>163<br>164<br>161 <sub>±5</sub> | 8.50<br>8.49<br>8.76<br>8.58 <sub>±.15</sub>  |
| 10         | 0.30<br>0.28<br>0.31<br>0.30 <sub>±.02</sub> | 0.47<br>0.51<br>0.37<br>0.45 <sub>±.07</sub> | 32<br>29<br>30<br>30 <sub>±2</sub> | 72.3<br>72.3<br>78.4<br>74.3 <sub>±3.5</sub> | 184<br>181<br>179<br>181 <sub>±3</sub> | 8.25<br>8.42<br>8.35<br>8.34 <sub>±.09</sub>  |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

TABLE 23 (Continued)

| STATION    | Hg                                       | Cd                                       | Pb                             | Cu                                       | Zn                                 | Ca<br>(x 1,000)                          |
|------------|------------------------------------------|------------------------------------------|--------------------------------|------------------------------------------|------------------------------------|------------------------------------------|
| 11         | 0.30<br>0.16<br>0.17<br><u>0.21</u> +.08 | 0.39<br>0.39<br>0.33<br><u>0.37</u> +.03 | 23<br>25<br>23<br><u>24</u> +1 | 70.9<br>67.2<br>68.1<br><u>68.7</u> +1.9 | 177<br>171<br>171<br><u>173</u> +4 | 8.62<br>8.43<br>8.51<br><u>8.52</u> +.10 |
| 12         | 0.34<br>0.40<br>0.30<br><u>0.35</u> +.05 | 0.34<br>0.37<br>0.36<br><u>0.36</u> +.02 | 27<br>27<br>28<br><u>27</u> +1 | 67.2<br>66.7<br>68.7<br><u>67.5</u> +1.0 | 170<br>166<br>170<br><u>169</u> +2 | 8.66<br>8.55<br>8.44<br><u>8.55</u> +.11 |
| 13         | 0.26<br>0.28<br>0.30<br><u>0.28</u> +.02 | 0.86<br>0.44<br>0.33<br><u>0.54</u> +.28 | 26<br>24<br>24<br><u>25</u> +1 | 73.7<br>66.3<br>67.4<br><u>69.1</u> +4.0 | 171<br>169<br>167<br><u>169</u> +2 | 8.08<br>8.53<br>8.15<br><u>8.25</u> +.24 |
| 14         | 0.39<br>0.31<br>0.34<br><u>0.35</u> +.04 | 0.33<br>0.51<br>0.37<br><u>0.40</u> +.09 | 24<br>27<br>23<br><u>25</u> +2 | 68.3<br>67.6<br>69.0<br><u>68.3</u> +.7  | 159<br>163<br>165<br><u>162</u> +3 | 8.92<br>8.22<br>8.15<br><u>8.43</u> +.43 |
| 14         |                                          |                                          |                                |                                          |                                    |                                          |
| 0-10 cm    | 0.22                                     | 0.36                                     | 18                             | 68.6                                     | 164                                | 8.41                                     |
| 10-20 cm   | 0.22                                     | 0.52                                     | 10                             | 60.8                                     | 133                                | 8.83                                     |
| 20-30 cm   | 0.20                                     | 0.51                                     | N.D.(3)                        | 51.8                                     | 117                                | 8.30                                     |
| 30-40 cm   | 0.13                                     | 0.47                                     | N.D.(3)                        | 50.3                                     | 117                                | 7.94                                     |
| 60-70 cm   | 0.20                                     | 0.77                                     | 10                             | 48.9                                     | 113                                | 8.11                                     |
| 90-100 cm  | 0.16                                     | 0.63                                     | N.D.(3)                        | 42.1                                     | 109                                | 8.51                                     |
| 140-150 cm | 0.19                                     | 0.59                                     | N.D.(3)                        | 41.9                                     | 109                                | 7.56                                     |
| 1          | 0.27<br>0.31<br>0.27<br><u>0.28</u> +.02 | 0.36<br>0.30<br>0.52<br><u>0.39</u> +.11 | 19<br>18<br>21<br><u>19</u> +2 | 59.8<br>62.4<br>59.3<br><u>60.5</u> +1.7 | 157<br>163<br>158<br><u>159</u> +3 | 8.42<br>8.96<br>8.73<br><u>8.70</u> +.27 |

\* All results expressed in ug/g dry weight  
 \*\*Numbers in brackets are limits of detection

TABLE 23 (Continued)

| STATION   | Hg        | Cd         | Pb   | Cu       | Zn     |
|-----------|-----------|------------|------|----------|--------|
| MESS - 1  |           |            |      |          |        |
| Certified | 0.17+0.01 | 0.59+ 0.10 | 34+6 | 25.1+3.8 | 191+17 |
| Found     | 0.20      | 0.46       | 25   | 24.3     | 179    |
|           | 0.18      | 0.51       | 25   | 24.4     | 179    |
|           | 0.18      | 0.54       | 23   | 23.5     | 174    |
|           | 0.17      | 0.53       | 26   | 24.1     | 180    |
|           | 0.21      | 0.51       | 28   | 26.1     | 179    |
| BCSS - 1  |           |            |      |          |        |
| Certified | 0.13+0.01 | 0.24+0.04  | 23+3 | 18.5+2.7 | 119+12 |
| Found     | 0.12      | 0.27       | 14   | 16.6     | 109    |
|           | 0.12      | 0.30       | 10   | 15.5     | 106    |
|           | 0.12      | 0.27       | 13   | 16.8     | 106    |
|           | 0.13      | 0.29       | 15   | 16.0     | 109    |
|           | 0.13      | 0.26       | 13   | 16.2     | 108    |

\* All results expressed as ug/g dry weight

**TABLE 24** BALLENAS BASIN OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - GRAB SAMPLES - APRIL 1986

| STATION | Hg   | Cd   | Pb | Cu   | Zn  | Ca<br>(x 1,000) |
|---------|------|------|----|------|-----|-----------------|
| 13      | 0.24 | 0.42 | 40 | 58.4 | 164 | 8.25            |
| 4       | 0.23 | 0.36 | 37 | 60.9 | 166 | 7.96            |
| 5       | 0.22 | 0.50 | 39 | 55.6 | 157 | 8.18            |
| 6       | 0.24 | 0.53 | 36 | 58.4 | 165 | 7.94            |
| 14      | 0.24 | 0.35 | 41 | 64.1 | 171 | 8.17            |
| 1       | 0.27 | 0.53 | 42 | 53.9 | 156 | 8.30            |
| 2       | 0.25 | 0.38 | 35 | 67.5 | 178 | 8.08            |
| 3       | 0.20 | 0.39 | 41 | 59.6 | 165 | 7.96            |
| 15      | 0.22 | 0.53 | 44 | 57.0 | 164 | 8.28            |
| 16      | 0.26 | 0.37 | 41 | 39.9 | 132 | 7.03            |
| 17      | 0.23 | 0.36 | 41 | 61.1 | 162 | 7.45            |
| 18      | 0.24 | 0.33 | 43 | 54.4 | 148 | 7.85            |

MESS - 1

|           |           |           |          |          |        |
|-----------|-----------|-----------|----------|----------|--------|
| Certified | 0.17±0.01 | 0.59±0.10 | 34.0±6.1 | 25.1±3.8 | 191±17 |
| Found     | 0.17      | 0.37      | 33       | 26.5     | 187    |
|           | 0.19      | 0.36      | 35       | 26.7     | 185    |
|           | 0.18      | 0.36      | 30       | 26.0     | 189    |
|           | 0.19      | 0.36      | 30       | 25.9     | 189    |
|           | 0.21      | 0.42      | 33       | 23.7     | 184    |

BCSS - 1

|           |           |           |          |          |        |
|-----------|-----------|-----------|----------|----------|--------|
| Certified | 0.13±0.01 | 0.25±0.04 | 22.7±3.4 | 18.5±2.7 | 119±12 |
| Found     | 0.13      | 0.41      | 21       | 17.4     | 114    |
|           | 0.12      | 0.23      | 22       | 18.3     | 120    |
|           | 0.12      | 0.30      | 24       | 13.8     | 99     |
|           | 0.14      | 0.31      | 27       | 12.5     | 97     |
|           | 0.14      | 0.21      | 27       | 17.7     | 115    |

\* All results expressed in ug/g dry weight

5.2.2 Northern Vancouver Island and B.C. Central Coast.

DUMPSITE: CAPE MUDGE  
NUMBER: 116  
CO-ORDINATES: 49°57.70'N 125°05.00'W  
DEPTH: 250 metres  
TOTAL QUANTITY  
DUMPED: 69 184 cubic metres  
LOADSITE INFORMATION:

The bulk of material dumped at the Cape Mudge site originates from the Campbell River area. In 1981, British Columbia Forest Products (B.C.F.P.) dredged 30,000 cubic metres of mud and wood debris from their Elk River Division logpond and booming ground located in the Campbell River estuary. This material was approved for ocean disposal under O.D.C.A. file number -01239 after pre-dredging sampling and analysis revealed no contamination. Public Works Canada dredged to deepen the harbour and ferry access channel at Campbell River in 1983. Pre-dredge sampling indicated elevated levels cadmium in surface sediments but not at depth. Approval under O.D.C.A. file number -01382 to dump 36,000 cubic metres of clay, sand and coarse gravel was conditional on sampling scows during the loading operation. Analysis of scow samples showed levels of cadmium below the guideline limit (ie: 0.6 ug/g). The Discovery Marina in Campbell River was deepened in 1986, resulting in 2,600 cubic metres of silt being dumped at the dumpsite under O.D.C.A. file number -01749.

In late spring and early summer, the Campbell River area is heavily utilized by rearing salmon and herring. To protect salmon stocks and minimize disruption of the local sport fishery, loading and dumping activities are generally restricted to the period December 1 through March 15. Lingcod are known to utilize bottom areas reasonably close to the dumpsite therefore, Fisheries and Oceans prefer to limit the disposal of fines which might cause siltation over a wide area.

#### RESEARCH INFORMATION:

No particular research studies have been directed to the Cape Mudge dumpsite, however, related studies on the effects of siltation and suspended sediment on bottom habitat have been discussed earlier for the Victoria dumpsite (O.D.C.A.R.F. 6.2.3, 7.2.4, 12.2.1 and 12.2.4). These studies may have particular relevance on the use of the area by spawning and rearing lingcod.

During the B.C.F.P. logpond dredging in 1981, marsh habitat in the Campbell River estuary, utilized by juvenile salmon, was destroyed. In a joint effort B.C.F.P., the Federal Department of Fisheries and Oceans and B.C. provincial agencies instigated a plan to replace the lost habitat by construction of artificial islands with dredge spoils otherwise destined for ocean disposal.

The islands were subsequently planted with grasses and a research study was begun to assess the progress of biological development and the physical characteristics of the islands as food and habitat resources for juvenile salmon (O.D.C.A.R.F. 9.2.4). The study showed that coarse-grained dredge materials can provide habitat which is more attractive to wild juvenile chinook fry than to hatchery stocks.

#### MONITORING INFORMATION:

Benthic sediment surveys were conducted in September 1981 and October 1984. (Figure 22).

Trace metal concentrations are not of concern at this location and show no trends between surveys (Tables 25 and 26).

A Pisces IV dive was completed in November 1983 (Appendix II). The area appears to support a large and varied benthic community in spite of obvious evidence of ocean dumping. At 180 metres, indications of strong bottom currents were observed which undoubtedly aid in the dispersion of disposed material.



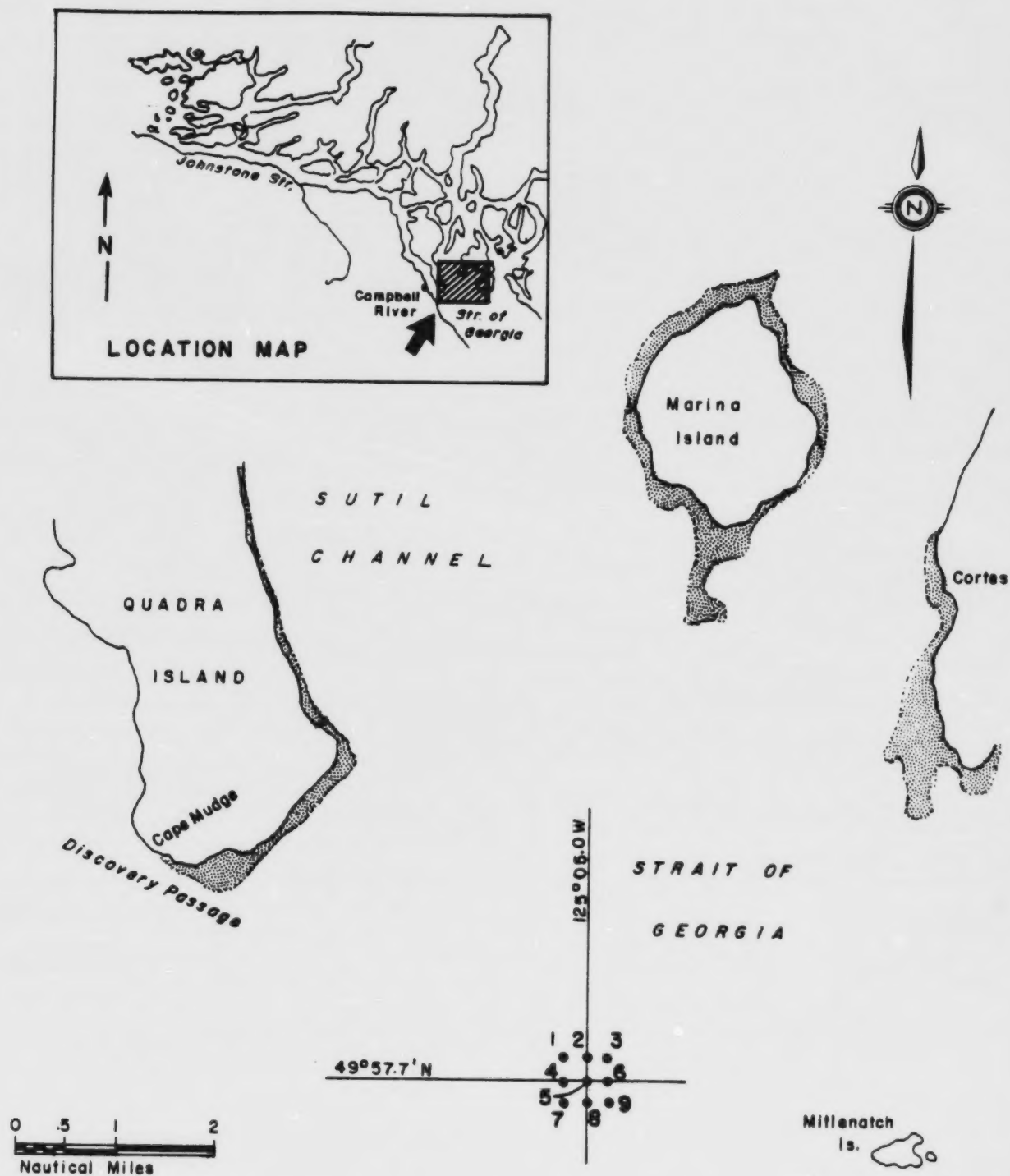


FIGURE 22 CAPE MUDGE OCEAN DUMPSITE - BENTHIC  
SEDIMENT SAMPLING STATIONS

**TABLE 25** CAPE MUDGE OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - GRAB SAMPLES - SEPTEMBER 1981

| STATION | Hg    | Cd          | Pb         | Cu   | Zn   |
|---------|-------|-------------|------------|------|------|
| 1       | 0.226 | N.D.(.57)** | N.D.(6.41) | 24.1 | 34.2 |
| 2       | 0.226 | N.D.(.57)   | N.D.(6.44) | 23.8 | 37.1 |
| 3       | 0.202 | N.D.(.57)   | 7.71       | 37.2 | 57.3 |
| 4       | 0.176 | N.D.(.57)   | N.D.(6.45) | 26.0 | 44.0 |
| 5       | 0.205 | N.D.(.57)   | N.D.(6.52) | 25.7 | 40.5 |
| 6       | 0.176 | N.D.(.57)   | 8.42       | 43.6 | 68.9 |
| 7       | 0.171 | N.D.(.58)   | N.D.(6.62) | 28.1 | 45.6 |
| 8       | 0.213 | N.D.(.57)   | 8.81       | 42.0 | 63.1 |
| 9       | 0.213 | N.D.(.58)   | 9.35       | 46.8 | 79.7 |

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\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

**TABLE 26** CAPE MUDGE OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\* IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION STANDARD DEVIATION - GRAB SAMPLES - OCTOBER 1984

| STATION | Hg                                             | Cd                                             | Pb                                    | Cu                                  | Zn                                   |
|---------|------------------------------------------------|------------------------------------------------|---------------------------------------|-------------------------------------|--------------------------------------|
| CM-1    | 0.08<br>0.07<br>0.08<br><u>0.08</u> $\pm$ 0.01 | 0.15<br>0.13<br>0.12<br><u>0.13</u> $\pm$ 0.02 | 18<br>14<br>14<br><u>15</u> $\pm$ 2.0 | 40<br>34<br>36<br><u>37</u> $\pm$ 3 | 62<br>55<br>58<br><u>58</u> $\pm$ 4  |
| CM-2    | 0.10<br>0.09<br>0.07<br><u>0.09</u> $\pm$ 0.02 | 0.20<br>0.23<br>0.15<br><u>0.19</u> $\pm$ 0.04 | 15<br>15<br>13<br><u>14</u> $\pm$ 1   | 40<br>42<br>41<br><u>41</u> $\pm$ 1 | 66<br>66<br>66<br><u>66</u> $\pm$ 0  |
| CM-3    | 0.11<br>0.12<br>0.12<br><u>0.12</u> $\pm$ 0.01 | 0.24<br>0.22<br>0.24<br><u>0.23</u> $\pm$ 0.01 | 15<br>21<br>19<br><u>18</u> $\pm$ 3   | 58<br>55<br>54<br><u>56</u> $\pm$ 2 | 88<br>86<br>88<br><u>87</u> $\pm$ 1  |
| CM-4    | 0.06<br>0.05<br>0.07<br><u>0.06</u> $\pm$ 0.01 | 0.10<br>0.28<br>0.10<br><u>0.16</u> $\pm$ 0.1  | 14<br>8<br>9<br><u>10</u> $\pm$ 3     | 32<br>24<br>31<br><u>29</u> $\pm$ 4 | 54<br>43<br>53<br><u>50</u> $\pm$ 6  |
| CM-5    | 0.07<br>0.07<br>0.08<br><u>0.07</u> $\pm$ 0.01 | 0.12<br>0.14<br>0.13<br><u>0.13</u> $\pm$ 0.01 | 16<br>15<br>16<br><u>16</u> $\pm$ 1   | 40<br>40<br>43<br><u>41</u> $\pm$ 2 | 60<br>61<br>67<br><u>63</u> $\pm$ 4  |
| CM-6    | 0.14<br>0.11<br>0.13<br><u>0.13</u> $\pm$ 0.02 | 0.16<br>0.16<br>0.22<br><u>0.18</u> $\pm$ 0.03 | 18<br>16<br>21<br><u>18</u> $\pm$ 3   | 47<br>44<br>58<br><u>50</u> $\pm$ 7 | 75<br>72<br>91<br><u>79</u> $\pm$ 10 |
| CM-7    | 0.06<br>0.06<br>0.07<br><u>0.06</u> $\pm$ 0.01 | 0.13<br>0.12<br>0.16<br><u>0.14</u> $\pm$ 0.02 | 21<br>18<br>18<br><u>19</u> $\pm$ 2   | 36<br>37<br>39<br><u>37</u> $\pm$ 2 | 62<br>59<br>61<br><u>61</u> $\pm$ 2  |

\* All results expressed in ug/g dry weight

TABLE 26 (Continued)

| STATION | Hg                                                                   | Cd                                                                   | Pb                                                 | Cu                                                 | Zn                                                          |
|---------|----------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------|----------------------------------------------------|-------------------------------------------------------------|
| CM-8    | 0.08<br>0.06<br>0.07<br><u>0.07</u> $\pm$ 0.01                       | 0.14<br>0.13<br>0.14<br><u>0.14</u> $\pm$ 0.01                       | 10<br>9<br>17<br><u>12</u> $\pm$ 4                 | 38<br>31<br>40<br><u>36</u> $\pm$ 5                | 65<br>56<br>65<br><u>62</u> $\pm$ 5                         |
| CM-9    | 0.13<br>0.10<br>0.08<br><u>0.10</u> $\pm$ 0.03                       | 0.18<br>0.15<br>0.13<br><u>0.15</u> $\pm$ 0.03                       | 19<br>13<br>10<br><u>14</u> $\pm$ 5                | 62<br>46<br>44<br><u>51</u> $\pm$ 10               | 84<br>67<br>65<br><u>72</u> $\pm$ 10                        |
| MESS-1  |                                                                      |                                                                      |                                                    |                                                    |                                                             |
| Cert.   | 0.17 $\pm$ 0.01                                                      | 0.59 $\pm$ 0.10                                                      | 34 $\pm$ 6                                         | 25 $\pm$ 4                                         | 191 $\pm$ 17                                                |
| Found   | 0.21<br>0.21<br>0.21<br>0.20<br>0.18<br>0.19<br>0.19<br>0.19<br>0.19 | 0.57<br>0.51<br>0.44<br>0.49<br>0.50<br>0.46<br>0.62<br>0.56<br>0.44 | 34<br>33<br>33<br>28<br>34<br>37<br>31<br>38<br>37 | 25<br>25<br>22<br>23<br>23<br>24<br>21<br>23<br>24 | 176<br>182<br>167<br>164<br>182<br>181<br>161<br>175<br>181 |
| BCSS-1  |                                                                      |                                                                      |                                                    |                                                    |                                                             |
| Cert.   | 0.13 $\pm$ 0.01                                                      | 0.24 $\pm$ 0.04                                                      | 23 $\pm$ 3                                         | 18 $\pm$ 3                                         | 119 $\pm$ 12                                                |
| Found   | 0.23<br>0.13<br>0.18<br>0.15<br>0.15<br>0.13<br>0.14<br>0.15<br>0.15 | 0.51<br>0.21<br>0.26<br>0.28<br>0.38<br>0.26<br>0.25<br>0.29<br>0.26 | 32<br>16<br>22<br>30<br>24<br>26<br>26<br>25<br>-  | 23<br>12<br>15<br>18<br>16<br>15<br>15<br>17<br>-  | 170<br>82<br>99<br>111<br>105<br>100<br>98<br>108<br>-      |

\* All results expressed in ug/g dry weight

DUMPSITE: KINGCOME INLET  
NUMBER: 75  
CO-ORDINATES: 50°55.00'N 126°13.00'W  
DEPTH: 125 metres  
TOTAL QUANTITY  
DUMPED: 38 349 cubic metres  
LOADSITE INFORMATION:

The Kingcome Inlet dump site was first used in 1977 by Bay Forest Products to dispose of 15,000 cubic metres of silt and woodwaste from their log booming area (O.D.C.A. file no. -00209). Silting from the Kingcome River and accumulation of woodwaste necessitated dredging/dumping again in 1984 under the name of Whonnock Industries Ltd. (O.D.C.A. file no. -01562). Sampling and analysis for mercury, cadmium, lead and polychlorinated biphenyl prior to dumping in 1984 indicated no contamination.

The Department of Fisheries and Oceans generally prohibit dredging/dumping after March 15 of any year to protect the seaward migration of juvenile salmon.

RESEARCH INFORMATION:

No research information available.

DUMPSITE: PORT ALICE, NEROUTSOS INLET  
NUMBER: 79  
CO-ORDINATES: 50°22.70'N 127°26.60'W  
DEPTH: 50 metres  
TOTAL QUANTITY  
DUMPED: 20 500 cubic metres  
LOADSITE INFORMATION:

The Port Alice dump site in Neroutsos Inlet was formally designated in 1983 for disposal of mud and wood debris from the Western Pulp Limited Partnership Ltd. pulp mill (previously owned by Rayonier Canada Ltd.). Maintenance dredging is necessary around the mill wood plants annually and at the deep sea dock occasionally. The dump site is located in deeper water a short distance south east of the mill and within the Company's lease area used for log booming. Chemical analysis of dredge spoils in 1985 suggested elevated levels of mercury around the deep sea dock, however, the analytical accuracy was questionable.

It is generally felt by R.O.D.A.C. that disposal of some contaminated sediments within the Company's lease area will not place a significant additional impact on the environment ie: 'like-on-like' dumping. There is concern, however, for the release of toxic hydrogen sulphide gas during the dredging of organic-rich sediments. To avoid fish mortalities during these operations, strict timing requirements are imposed by the Department of Fisheries and Oceans (D.F.O.). To ensure the protection of adult and juvenile salmon which utilize the area during certain times of the year, D.F.O. generally allow dredging/dumping from November 1 to February 28 and for a limited number of days from July 1 to August 31.

**RESEARCH INFORMATION:**

Many water quality and biological studies have been conducted in Neroutsos Inlet to determine effects of pulpmill effluent on the receiving environment. There are no reports to date pertaining specifically to ocean dumping.

DUMPSITE: TAHSIS INLET  
NUMBER: 83  
CO-ORDINATES: 49°51.60'N 126°39.60'W  
DEPTH: 200 metres  
TOTAL QUANTITY  
DUMPED: 134 034 cubic metres  
LOADSITE INFORMATION:

For the purpose of discussion the Tahsis Inlet dump site will be combined with the Muchalat Inlet (no. 117) and the Eliza Passage (no. 118) dump sites. All three sites are used for disposal of dredge spoil from forest industry operations in the area. C.I.P. Inc., Tahsis Pacific Region (formerly known as Tahsis Company Ltd.), operate a pulp mill and logging operation at Gold River, two sawmills (Hemlock and Cedar) at Tahsis and various log dumps in the nearby inlet systems. Prior to 1980, the dredge spoils from Gold River were dumped at a site in Zuciarte Channel near the mouth of Muchalat Inlet. In 1980, the Muchalat Inlet site was designated for these spoils, plus material dredged from the logging operation near Gold River. The site receives between 10 000 and 25 000 cubic metres of marine sediments and woodwastes annually.

All of the dredge spoils from the two Tahsis sawmills and some spoils from nearby log dumps go to the Tahsis Inlet dump site established in 1976. This disposal amounts to between 10 000 and 15 000 cubic metres of marine sediments and woodwastes annually. A much smaller volume is dumped at the Eliza Passage dump site which was established in 1980 to accommodate material from various log dumps. Samples of the material destined for ocean disposal have been collected over the years and analysed for cadmium, mercury, lead and polychlorinated biphenyls. On occasion elevated levels for cadmium and mercury have been reported, however, the extent of contamination was minimal. During the 1984/85 dredging season, the company was required to sample scows during loading operations. These data indicated trace metal levels below the guideline concentrations



specified in the O.D.C.A. Sediment chemistry studies at the dump sites used by C.I.P. Tahsis indicated elevated levels of cadmium, copper and zinc suggesting relatively high natural mineralization in the area.

The Department of Fisheries and Oceans is concerned about the possible release of toxic hydrogen sulphide gas during the dredging of organic-rich sediments. Dredging/loading and ocean dumping of sediments containing a large amount of woodwaste are generally prohibited from March 1 to July 14 and from August 16 to November 30 to protect rearing and migrating salmon.

#### **RESEARCH INFORMATION:**

No research information available.

#### **MONITORING INFORMATION:**

Benthic sediment surveys were conducted at the dumpsite and stations in Tahsis Inlet in August 1984 (Figure 23).

Cadmium concentrations recorded in sediments were in excess of O.D.C.A. scheduled criteria throughout the inlet (range 0.44 - 1.43 ug/g) and to a depth of 70 cm. in a core sample at the dumpsite (Table 27).

In March 1977, two Pisces IV dives were completed in Tahsis Inlet (Petrie and Holman, 1983). Dive records indicated the benthic infaunal community had been eradicated by dumping activity, although epifauna was still present. Wood debris from dumping activity was covered with the bacterial slime common at most dumpsites.

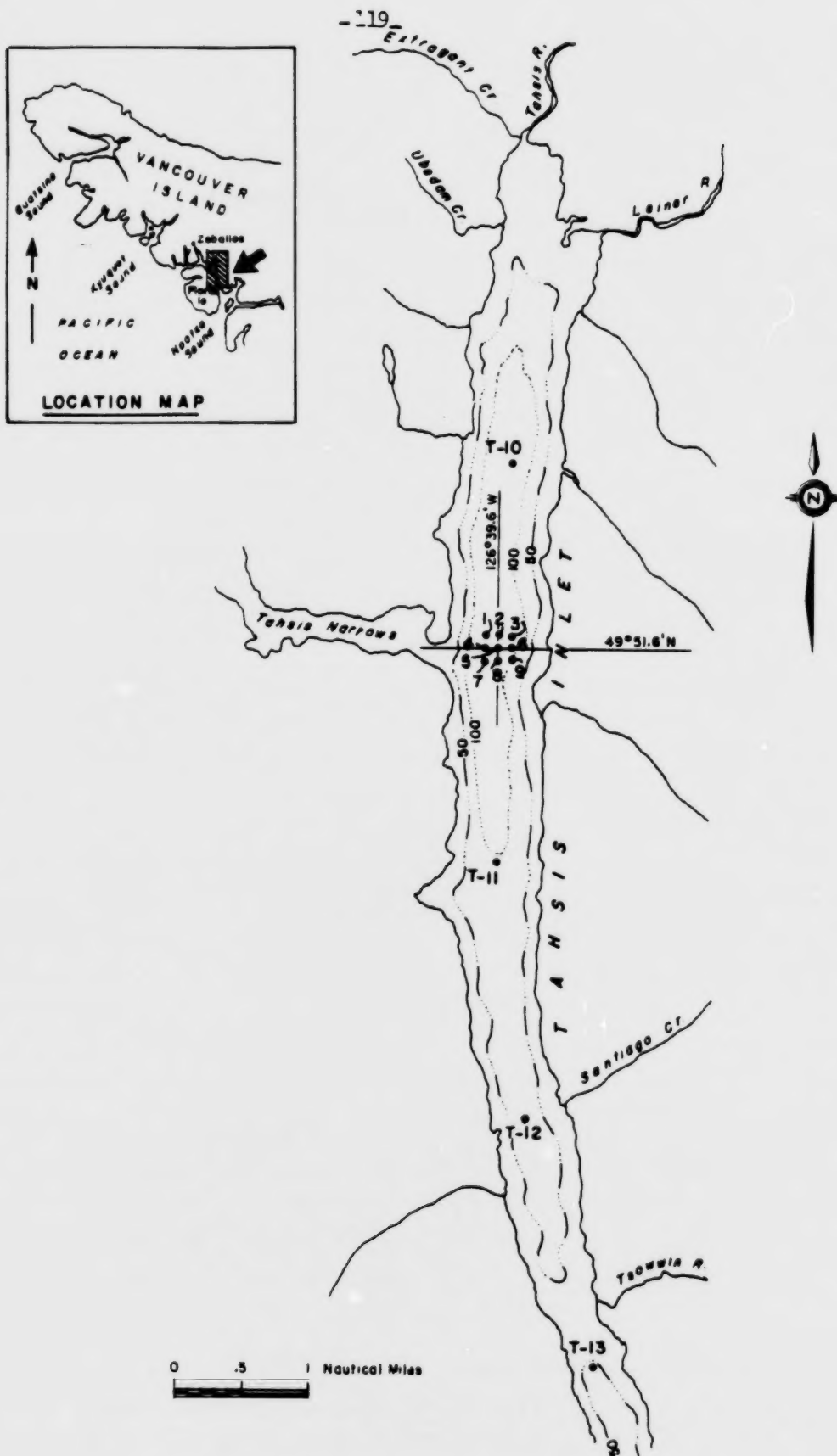


FIGURE 23 TAHSIS INLET OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

**TABLE 27** TAHSIS INLET OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB AND CORE SAMPLES - AUGUST 1984

| STATION         | Hg                                                  | Cd                                             | Pb                                 | Cu                                            | Zn                                        |
|-----------------|-----------------------------------------------------|------------------------------------------------|------------------------------------|-----------------------------------------------|-------------------------------------------|
| TI-1            | 0.240<br>0.180<br>0.174<br><u>0.198</u> $\pm$ 0.036 | 0.90<br>0.88<br>0.83<br><u>0.87</u> $\pm$ 0.4  | 8<br>4<br>8<br>7 $\pm$ 2           | 73.6<br>68.9<br>75.8<br><u>72.8</u> $\pm$ 3.5 | 96.4<br>106<br>190<br><u>131</u> $\pm$ 51 |
| TI-2            | 0.207<br>0.188<br>0.163<br><u>0.186</u> $\pm$ 0.022 | 1.35<br>1.36<br>0.81<br><u>1.17</u> $\pm$ 0.31 | 5<br>N.D.(3)<br>N.D.(3)<br>-       | 83.0<br>74.3<br>74.3<br><u>77.2</u> $\pm$ 5.0 | 112<br>114<br>108<br><u>111</u> $\pm$ 3   |
| TI-3            | 0.179<br>0.178<br>0.183<br><u>0.181</u> $\pm$ 0.004 | 1.43<br>0.90<br>1.07<br><u>1.13</u> $\pm$ 0.27 | N.D.(3)<br>N.D.(3)<br>N.D.(3)<br>- | 70.8<br>68.4<br>69.9<br><u>69.7</u> $\pm$ 1.2 | 105<br>106<br>104<br><u>105</u> $\pm$ 1   |
| TI-4            | 0.147<br>0.122<br>0.133<br><u>0.134</u> $\pm$ 0.012 | 0.70<br>0.87<br>0.69<br><u>0.75</u> $\pm$ 0.10 | N.D.(3)<br>N.D.(3)<br>N.D.(3)<br>- | 80.6<br>114<br>91.9<br><u>95.5</u> $\pm$ 16.9 | 307<br>111<br>109<br><u>175</u> $\pm$ 11  |
| TI-5            | 0.204<br>0.158<br>0.145<br><u>0.169</u> $\pm$ 0.031 | 0.59<br>0.76<br>0.86<br><u>0.74</u> $\pm$ 0.14 | N.D.(3)<br>N.D.(3)<br>N.D.(3)<br>- | 85.3<br>81.9<br>80.7<br><u>82.6</u> $\pm$ 2.3 | 97.1<br>106<br>99.8<br><u>101</u> $\pm$ 5 |
| TI-5<br>0-10 cm | 0.128                                               | 1.23                                           | N.D.(3)                            | 53.4                                          | 81.8                                      |
| 30-40 cm        | 0.132                                               | 1.10                                           | N.D.(3)                            | 63.8                                          | 87.2                                      |
| 60-70 cm        | 0.114                                               | 1.39                                           | N.D.(3)                            | 58.8                                          | 87.1                                      |
| TI-6            | 0.160<br>0.164<br>0.172<br><u>0.165</u> $\pm$ 0.006 | 0.82<br>1.01<br>1.10<br><u>0.98</u> $\pm$ 0.14 | N.D.(3)<br>N.D.(3)<br>N.D.(3)<br>- | 51.8<br>63.5<br>62.8<br><u>59.4</u> $\pm$ 6.6 | 100<br>103<br>103<br><u>102</u> $\pm$ 1.  |
| TI-7            | 0.193<br>0.146<br>0.158<br><u>0.166</u> $\pm$ 0.024 | 0.44<br>0.66<br>0.94<br><u>0.68</u> $\pm$ 0.25 | N.D.(3)<br>N.D.(3)<br>N.D.(3)<br>- | 64.4<br>50.2<br>53.6<br><u>56.1</u> $\pm$ 7.4 | 106<br>97.4<br>105<br><u>103</u> $\pm$ 5  |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

TABLE 27 (Continued)

| STATION | Hg                                                  | Cd                                             | Pb                                  | Cu                                            | Zn                                            |
|---------|-----------------------------------------------------|------------------------------------------------|-------------------------------------|-----------------------------------------------|-----------------------------------------------|
| TI-8    | 0.126<br>0.088<br>0.128<br><u>0.114</u> $\pm$ 0.022 | 0.77<br>0.75<br>0.92<br><u>0.81</u> $\pm$ 0.09 | N.D.(3)<br>N.D.(3)<br>N.D.(3)<br>-  | 66.6<br>69.6<br>65.5<br><u>67.2</u> $\pm$ 2.1 | 108<br>105<br>105<br><u>106</u> $\pm$ 2       |
| TI-9    | 0.199<br>0.171<br>0.158<br><u>0.176</u> $\pm$ 0.020 | 0.88<br>0.97<br>0.93<br><u>0.93</u> $\pm$ 0.04 | N.D.(3)<br>N.D.(3)<br>N.D.(3)<br>-  | 65.6<br>67.7<br>66.2<br><u>66.5</u> $\pm$ 1.1 | 101<br>105<br>105<br><u>103</u> $\pm$ 2       |
| TI-10   | -<br>0.233<br>0.324<br>-                            | 0.78<br>0.77<br>0.86<br><u>0.80</u> $\pm$ 0.05 | N.D.(3)<br>N.D.(3)<br>N.D.(3)<br>-  | 111<br>109<br>108<br><u>109</u> $\pm$ 2       | 98.9<br>104<br>97.5<br><u>100</u> $\pm$ 3     |
| TI-11   | 0.210<br>0.199<br>0.221<br><u>0.210</u> $\pm$ 0.011 | 0.85<br>0.98<br>0.73<br><u>0.85</u> $\pm$ 0.12 | 5<br>N.D.(3)<br>3<br>-              | 62.8<br>59.9<br>62.5<br><u>61.7</u> $\pm$ 1.6 | 102<br>97.9<br>99.9<br><u>99.9</u> $\pm$ 2.1  |
| TI-12   | 0.162<br>0.133<br>0.162<br><u>0.152</u> $\pm$ 0.017 | 0.80<br>0.70<br>0.76<br><u>0.75</u> $\pm$ 0.5  | N.D.(3)<br>N.D.(3)<br>N.D.(3)<br>-  | 41.5<br>36.2<br>41.6<br><u>39.8</u> $\pm$ 3.1 | 91.2<br>84.7<br>89.2<br><u>88.4</u> $\pm$ 3.3 |
| TI-13   | 0.148<br>0.160<br>1.120<br><u>0.476</u> $\pm$ 0.558 | 0.80<br>0.84<br>1.10<br><u>0.91</u> $\pm$ 0.16 | 10<br>12<br>13<br><u>11</u> $\pm$ 2 | 45.6<br>49.4<br>47.3<br><u>47.4</u> $\pm$ 1.9 | 90.5<br>118<br>89.9<br><u>99.5</u> $\pm$ 16.0 |

\* All results expressed in ug/g dry weight

\*\* Numbers in brackets are limits of detection

TABLE 27 (Continued)

| STATION           | Hg                | Cd              | Pb             | Cu             | Zn           |
|-------------------|-------------------|-----------------|----------------|----------------|--------------|
| MESS-1            |                   |                 |                |                |              |
| Cert.             | 0.171 $\pm$ 0.014 | 0.59 $\pm$ 0.10 | 34 $\pm$ 6.1   | 25.1 $\pm$ 3.8 | 191 $\pm$ 17 |
| Found             | 0.205             | 0.59            | 25             | 21.9           | 175          |
|                   | 0.195             | 0.61            | 26             | 24.4           | 185          |
|                   | -                 | 0.64            | 28             | 23.2           | 195          |
|                   | -                 | -               | 29             | 25.0           | 191          |
|                   | -                 | -               | 26             | 22.3           | 178          |
|                   | -                 | -               | 27             | 24.7           | 188          |
| BCSS-1            |                   |                 |                |                |              |
| Cert.             | 0.129 $\pm$ 0.012 | 0.25 $\pm$ 0.04 | 22.7 $\pm$ 3.4 | 18.5 $\pm$ 2.7 | 119 $\pm$ 12 |
| Found             | 0.153             | 0.28            | 12             | 15.2           | 111          |
|                   | 0.147             | 0.31            | 17             | 16.5           | 116          |
|                   | -                 | 0.28            | 15             | 16.2           | 114          |
|                   | -                 | -               | 13             | 14.6           | 108          |
|                   | -                 | -               | 15             | 15.8           | 110          |
|                   | -                 | -               | -              | -              | -            |
| SAMPLE TI-13 ONLY |                   |                 |                |                |              |
| MESS-1            |                   |                 |                |                |              |
| Cert.             | 0.171 $\pm$ 0.014 | 0.59 $\pm$ 0.10 | 34 $\pm$ 6.1   | 25.1 $\pm$ 3.8 | 191 $\pm$ 17 |
| Found             | 0.185             | 0.48            | 28             | 24.5           | 189          |
|                   | 0.200             | 0.49            | 27             | 23.1           | 173          |
|                   | 0.187             | 0.50            | 27             | 23.5           | 182          |
|                   | -                 | -               | 34             | 27.5           | 209          |
|                   | -                 | -               | 27             | 25.3           | 185          |
|                   | -                 | -               | 28             | 23.3           | 176          |
| BCSS-1            |                   |                 |                |                |              |
| Cert.             | 0.129 $\pm$ 0.012 | 0.25 $\pm$ 0.04 | 22.7 $\pm$ 3.4 | 18.5 $\pm$ 2.7 | 119 $\pm$ 12 |
| Found             | 0.131             | 0.27            | 19             | 16.2           | 109          |
|                   | 0.143             | 0.28            | 19             | 16.8           | 118          |
|                   | 0.149             | 0.28            | 19             | 16.2           | 110          |
|                   | -                 | -               | 21             | 16.6           | 113          |
|                   | -                 | -               | 19             | 16.1           | 112          |
|                   | -                 | -               | -              | -              | -            |

\* All results expressed in ug/g dry weight  
 \*\* Numbers in brackets are limits of detection

DUMPSITE: NEWCOMBE CHANNEL  
NUMBER: 86  
CO-ORDINATES: 48°54.70'N 125°29.30'W  
DEPTH: 60 metres  
TOTAL QUANTITY  
DUMPED: 61 110 cubic metres  
COMMENTS:

Site location of historic dumpsite in Newcombe Channel.

**LOADSITE INFORMATION:**

Refer to the discussion for Ucluelet dump site (no. 145).

**RESEARCH INFORMATION:**

Refer to the discussion for Ucluelet dump site (no. 145).

DUMPSITE: UCLUELET  
NUMBER: 145  
CO-ORDINATES: 48°53.60'N 125°32.50'W  
DEPTH: 100 metres  
TOTAL QUANTITY  
DUMPED: NIL  
COMMENTS:

New dumpsite designated in November 1980. Site has not been utilized to date.

**LOADSITE CONCERNS:**

The Ucluelet dumpsite was designated in 1980 to accommodate dredge spoils originating in Ucluelet Inlet. A historical dumpsite located at 48°54.7'N, 125°29.3'W in Newcombe Channel (See Dumpsite #86) had been used by British Columbia Forest Products prior to the O.D.C.A. coming into effect. It was felt by the Department of Fisheries and Oceans (D.F.O.) that this site should not be used for disposal of material containing a large proportion of organics (woodwastes) due to its proximity to land and relatively shallow depth (60 metres). The newly designated site is several kilometres off-shore at a depth of 100 metres. Unfortunately, the new location is subject to adverse sea and weather conditions much of the year making transport and dumping costs very high.

To protect rearing and spawning salmon and herring populations, D.F.O. generally restrict dredging/loading and dumping operations to the periods, July 15 to August 15, and from November 15 to February 15. There is also fishery concern for the release of hydrogen sulphide gas and high oxygen demand when dredging occurs in areas rich in organic debris.

In 1982, Public Works Canada were granted approval (O.D.C.A. file no. -01027) to dump 60,000 cubic metres of marine sediments from a harbour



expansion project at the Newcombe Channel dumpsite after providing information to indicate that the costs of using the new site were prohibitive. The sediments at the dredge site were shown to be uncontaminated and contain little woodwaste in a pre-dredging sampling program in November 1980.

In 1983, MacMillan Bloedel (M & B) collected surface samples from the head of the inlet in support of an application (O.D.C.A. file no. -01473) to load and dump 2,000 cubic metres of marine sediments containing about 50% woodwaste. The analytical data indicated a high level of contamination by cadmium (1.5 to 9.2 ug/g). M & B's proposal to dump at the Newcombe Channel dumpsite was opposed by D.F.O. due to the high organic content. D.F.O. reiterated their long held position that M & B should construct a dryland sorting area at the head of the inlet to reduce the impact on water quality and fish habitat. R.O.D.A.C. opposed dumping at the Ucluelet dumpsite due to the high cadmium levels and rejected the application.

In 1985, M & B submitted another application to conduct a similar operation (O.D.C.A. file no. -01856). The company collected additional surface samples and arranged for the Noranda Research Centre, Québec, to conduct a study to determine the degree and extent of cadmium contamination. The latter study involved core sampling, sediment traps and mussel tissue analysis. The results, while not identifying the source, indicated that cadmium contamination was relatively wide spread in the inlet with the highest levels at the head of the inlet and extending to a depth of at least 30 centimetres in core samples. This suggested that the cadmium had been in the area for some years; however, the sediment traps, collecting suspended particulates, also showed high cadmium levels (3.5 to 5.5 ug/g). On a positive note, the mussel tissue levels were not elevated suggesting that the cadmium was not biologically available. Based on the mussel data and the belief that the spoils would be rapidly rendered harmless by physical processes at the Ucluelet dumpsite, R.O.D.A.C. approved disposal of the 2,000 cubic metres of material. The approval was never used, however, and M & B cited excessive towing distances and costs as reasons for cancellation

of the proposed ocean disposal. The material in question was deposited at the Kennedy Lake Woodlands Division landfill site. The Ucluelet ocean dumpsite has therefore never been used, however, it remains a option when circumstances make disposal in Newcombe Channel unacceptable.

#### RESEARCH INFORMATION:

In an attempt to more accurately define the cadmium distribution in Ucluelet Inlet and distinguish between natural and anthropogenic sources, a research study (O.D.C.A.R.F. 12.2.3) was initiated in 1986. The study, which is currently underway, involves elemental analysis and lead 210 dating of core samples and, elemental analysis of water and sediments from fresh water streams in the vicinity.

#### MONITORING INFORMATION:

Benthic sediment surveys were conducted in March 1982 and July 1986 (Figure 24).

Trace metal concentrations are not of concern at this site (Tables 28 and 29).

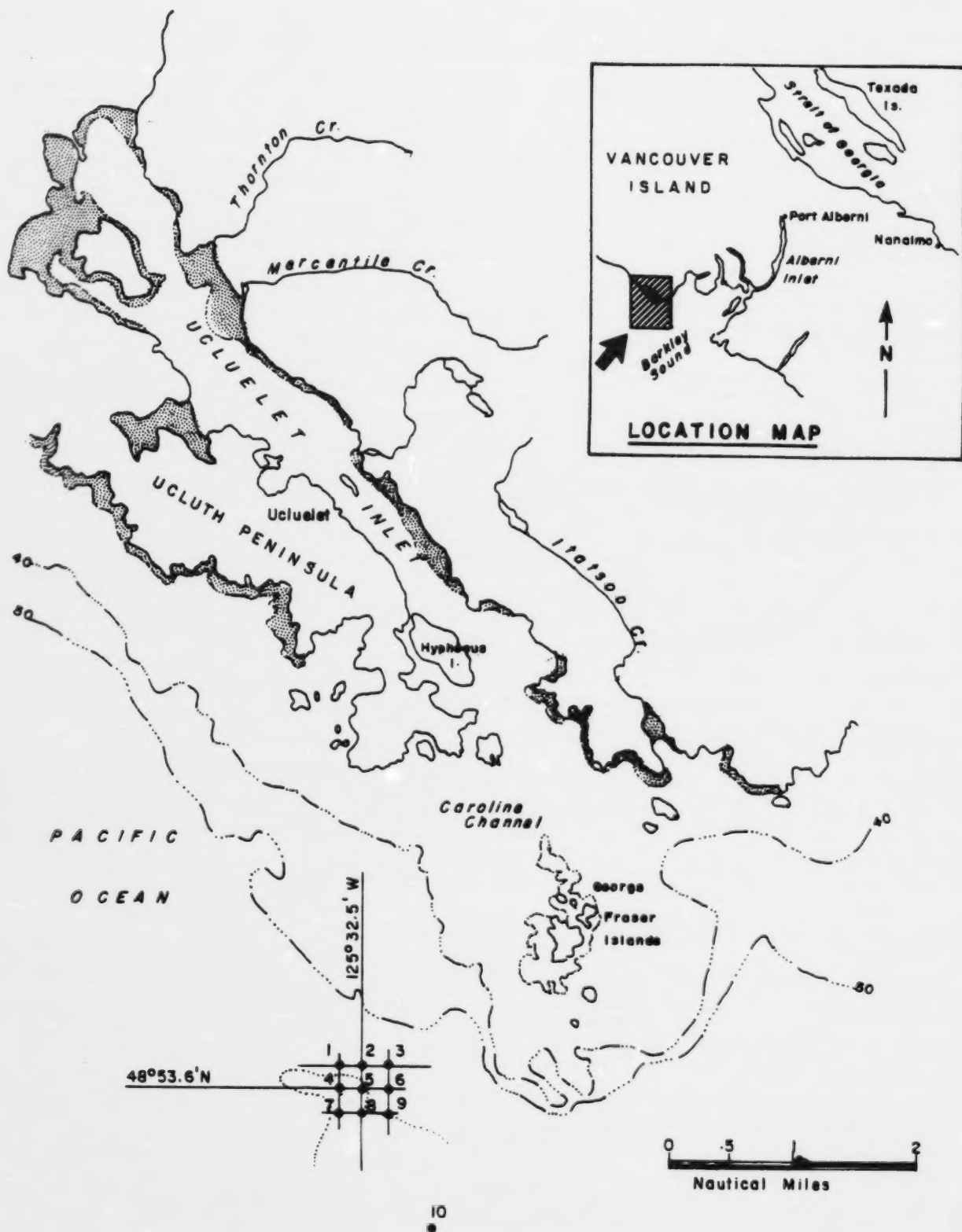


FIGURE 24 UCLUELET OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

**TABLE 28** UCLUELET INLET OCEAN DUMP SITE- TRACE METAL  
METAL CONCENTRATIONS\* IN BENTHIC SEDIMENTS  
GRAB SAMPLES - MARCH 1982

| STATION | Hg   | Cd         | Pb | Cu   | Zn   |
|---------|------|------------|----|------|------|
| 2       | 0.19 | N.D.(.2)** | 13 | 22.4 | 65.5 |
| 4       | 0.19 | 0.5        | 17 | 27.8 | 77.7 |
| 5       | 0.18 | 0.4        | 15 | 24.9 | 70.9 |
| 6       | 0.17 | 0.3        | 16 | 26.5 | 71.2 |
| 8       | 0.27 | 0.3        | 14 | 27.0 | 73.7 |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

**TABLE 29** UCLUELET OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB SAMPLES - JULY 1986

| STATION | Hg                                             | Cd                                             | Pb                                  | Cu                                            | Zn                                               |
|---------|------------------------------------------------|------------------------------------------------|-------------------------------------|-----------------------------------------------|--------------------------------------------------|
| 1       | 0.09<br>0.07<br>0.06<br><u>0.08</u> $\pm$ 0.01 | 0.51<br>0.34<br>0.25<br><u>0.43</u> $\pm$ 0.12 | 18<br>19<br>20<br><u>19</u> $\pm$ 1 | 20.0<br>21.4<br>30.0<br><u>23.8</u> $\pm$ 5.4 | 71.2<br>71.0<br>68.9<br><u>70.3</u> $\pm$ 1.3    |
| 2       | 0.08<br>0.11<br>0.09<br><u>0.10</u> $\pm$ 0.02 | 1.69<br>0.31<br>0.29<br><u>0.76</u> $\pm$ 0.80 | 18<br>22<br>18<br><u>19</u> $\pm$ 2 | 21.8<br>24.7<br>21.8<br><u>22.8</u> $\pm$ 1.7 | 82.4<br>99.2<br>82.4<br><u>88.0</u> $\pm$ 9.7    |
| 3       | 0.18<br>0.10<br>0.11<br><u>0.13</u> $\pm$ 0.04 | 0.41<br>0.82<br>0.67<br><u>0.63</u> $\pm$ 0.21 | 15<br>22<br>23<br><u>20</u> $\pm$ 4 | 18.2<br>20.1<br>21.7<br><u>20.0</u> $\pm$ 1.8 | 79.1<br>82.2<br>85.6<br><u>80.7</u> $\pm$ 2.2    |
| 4       | 0.15<br>0.10<br>0.12<br><u>0.12</u> $\pm$ 0.03 | 0.59<br>0.61<br>0.53<br><u>0.58</u> $\pm$ 0.04 | 24<br>24<br>22<br><u>23</u> $\pm$ 1 | 29.8<br>28.9<br>28.5<br><u>29.1</u> $\pm$ 0.7 | 99.2<br>98.9<br>99.3<br><u>99.1</u> $\pm$ 0.2    |
| 5       | 0.10<br>0.12<br>0.11<br><u>0.11</u> $\pm$ 0.01 | 0.54<br>0.63<br>1.45<br><u>0.87</u> $\pm$ 0.50 | 23<br>22<br>23<br><u>23</u>         | 26.3<br>25.8<br>26.4<br><u>26.2</u> $\pm$ 0.3 | 91.1<br>90.4<br>93.4<br><u>91.6</u> $\pm$ 1.6    |
| 6       | 0.06<br>0.11<br>0.06<br><u>0.08</u> $\pm$ 0.03 | 0.48<br>0.53<br>0.55<br><u>0.52</u> $\pm$ 0.04 | 18<br>20<br>22<br><u>20</u> $\pm$ 2 | 18.3<br>20.4<br>21.3<br><u>20.0</u> $\pm$ 1.5 | 76.2<br>82.0<br>83.9<br><u>80.7</u> $\pm$ 4.0    |
| 7       | 0.11<br>0.10<br>0.08<br><u>0.10</u> $\pm$ 0.02 | 0.49<br>0.52<br>0.47<br><u>0.49</u> $\pm$ 0.03 | 22<br>28<br>28<br><u>26</u> $\pm$ 3 | 28.2<br>33.1<br>32.4<br><u>31.2</u> $\pm$ 2.7 | 99.6<br>101.0<br>100.0<br><u>100.0</u> $\pm$ 1.0 |

\* All results expressed as ug/g dry weight

TABLE 29 (Continued)

| STATION | Hg              | Cd              | Pb             | Cu             | Zn             |
|---------|-----------------|-----------------|----------------|----------------|----------------|
| 8       | 0.11            | 0.75            | 24             | 28.4           | 96.8           |
|         | 0.11            | 0.53            | 22             | 27.2           | 96.9           |
|         | 0.10            | 0.46            | 21             | 27.6           | 97.2           |
|         | $0.11 \pm 0.01$ | $0.58 \pm 0.15$ | $22 \pm 2$     | $27.7 \pm 0.6$ | $97.0 \pm 0.2$ |
|         |                 |                 |                |                |                |
| 9       | 0.08            | 0.63            | 18             | 22.2           | 83.4           |
|         | 0.08            | 0.82            | 22             | 22.4           | 81.7           |
|         | 0.15            | 0.66            | 21             | 22.1           | 78.4           |
|         | $0.10 \pm 0.04$ | $0.70 \pm 0.10$ | $20 \pm 2$     | $22.2 \pm 0.2$ | $81.2 \pm 3.5$ |
|         |                 |                 |                |                |                |
| 10      | 0.06            | 0.73            | 26             | 29.0           | 96.1           |
|         | 0.07            | 0.86            | 25             | 27.8           | 93.0           |
|         | 0.08            | 0.81            | 25             | 28.4           | 91.0           |
|         | $0.07 \pm 0.01$ | $0.80 \pm 0.07$ | $25 \pm 1$     | $28.4 \pm 0.6$ | $93.4 \pm 2.6$ |
|         |                 |                 |                |                |                |
| MESS-1  |                 |                 |                |                |                |
| Cert.   | $0.17 \pm 0.01$ | $0.59 \pm 0.10$ | $34.0 \pm 6.1$ | $25.1 \pm 3.8$ | $191 \pm 17$   |
| Found   | 0.16            | 0.68            | 38             | 23.6           | 192            |
|         | 0.17            | 0.77            | 41             | 24.4           | 200            |
|         | 0.16            | 0.69            | 42             | 24.2           | 195            |
|         | 0.16            | 0.69            | 46             | 24.4           | 198            |
|         | 0.18            | 0.73            | 46             | 24.9           | 199            |
| BCSS-1  |                 |                 |                |                |                |
| Cert.   | $0.13 \pm 0.01$ | $0.25 \pm 0.04$ | $22.7 \pm 3.4$ | $18.5 \pm 2.7$ | $119 \pm 12$   |
| Found   | 0.16            | 0.25            | 37             | 17.1           | 120            |
|         | 0.13            | 0.27            | 34             | 17.7           | 123            |
|         | 0.13            | 0.27            | 35             | 16.5           | 120            |
|         | 0.13            | 0.27            | 32             | 16.3           | 120            |
|         | 0.13            | 0.26            | 30             | 15.4           | 118            |

\* All results expressed as ug/g dry weight

DUMPSITE: PORT ALBERNI  
NUMBER: 88  
CO-ORDINATES: 49°12.00'N 124°49.3'W  
DEPTH: 45 metres  
TOTAL QUANTITY  
DUMPED: 717 823 cubic metres  
COMMENTS:

Site in use since 1973. Previously referred to as Alberni Inlet.

**LOADSITE INFORMATION:**

The major user of the Port Alberni dumpsite is MacMillan Bloedel (M & B). M & B has various forest industry operations in Alberni Harbour requiring annual maintenance dredging with ocean disposal of spoils. The M & B operations include:

- Alberni Pulp and Paper (Alpulp) - a groundwood pulpmill
- Somass Division - a sawmill
- Alberni Pacific Division - plywood and pine mills
- Sproat Lake and Canal Sort - log dump and handling facilities

Various environmental impact studies have been conducted in past years to determine the adverse effects of the M & B operations and in particular of the mill effluent originating from Alpulp. A general discussion of the effects on water quality and benthic communities can be found in E.P.S. Regional Program Report: 79-11 (Nelson 1979) and in Morris and Leaney, (1980).

Alpulp is located at the mouth of the Somass River, a major salmon producing river. The estuary is utilized as a rearing ground for juvenile salmon and a migration route for adult salmon heading up the river system



to spawn. The Department of Fisheries and Oceans generally prohibits loading/dredging and ocean dumping activities from March 1 to October 14 to avoid interference with the downstream migration of juvenile salmon and the adult salmon entering the system. Fishery resource sensitivities also exist at the dumpsite because of its close proximity to Follinsbee Creek, an area known to support commercial and recreational crab, salmon and shrimp fisheries.

Over the years, various potential contaminant problems have been investigated in Alberni Harbour. In 1973, elevated levels of zinc reported for inner harbour sediments were suspected to have originated from the use of zinc dithionite as a brightening agent for newsprint (Nelson and Goyette 1976). This practice was discontinued at groundwood pulpmills around the mid 1970's when it was discovered that oysters and clams were accumulating the zinc. It is believed that harbour sediments and the sludge in Alpulp's biobasin (treatment pond) continued to contain elevated levels of zinc, and possibly cadmium. The biobasin sludge was discharged via Alpulp's effluent outfall in the winters of 1980/81 and 1981/82 into an area known as the 'west storage area' or 'west berth' at the deep sea dock.

The west storage area routinely requires maintenance dredging with disposal of spoils at the dumpsite. Sediments collected from this area in 1984 were shown to be toxic in amphipod bioassays (Chapman and Barlow, 1984).

Extensive sediment and scow sampling programs by E.P.S. and M & B between 1982 and 1985 in this area and at the other M & B operations, failed to identify a serious contamination problem associated with dredge spoils. The zinc levels, although elevated at the Alpulp dredge site and to a lesser extent at the dumpsite, were not considered hazardous as no harvestable clams or oysters are found in these areas or for several miles out the inlet. The levels for cadmium were found to be elevated (ie: 1 to 2 ug/g throughout Alberni Harbour and out to Barkeley Sound in both surface grab samples and

core samples.

Mercury contamination reported in a 1982 study may have resulted from the historical use of mercurial slimicides in the mill or from mercury contaminated sludge released from the biobasin. Subsequent sampling programs of loaded scows and the dumpsite have failed to detect mercury contamination; therefore, sampling and/or analytical biases may have been reflected in the 1982 data. Likewise, the inconsistency of data showing occasional elevated levels of polychlorinated biphenyl (P.C.B.) for different areas in Alberni Harbour suggest sampling/analytical problems or patch contaminant sources. In any case, the scow sampling during dredging operations and subsequent sampling after disposal at the dumpsite have not indicated any pollution problem from heavy metal or organic contaminants. This has been confirmed by research studies at the dumpsite (see below).

A potential source of environmental impact exists in Alberni Harbour during dredging operations involving organic rich sediments with a high oxygen demand. Thick layers of decomposing wood debris and pulp fibre at various locations in the harbour are a source of toxic hydrogen sulfide gas and when disturbed may result in a sharp decrease in oxygen levels in overlying water. Dredging operations in these areas must adhere to strict D.F.O. timing guidelines to ensure fishery resources are not endangered. Disposal of organic rich sediments at the dumpsite is not expected to cause an oxygen depletion problem owing to dilution and a high probability of annual flushing. Research studies suggest that the major source of impact at the dumpsite is the physical smothering of benthic animals in a very localized area (see below).

#### **RESEARCH INFORMATION:**

In the last ten years (1976 - 1986), numerous research studies related to the Port Alberni dumpsite have been funded through the Ocean Dumping Control Act Research Fund (O.D.C.A.R.F.). These studies can

generally be grouped into three categories:

- Benthic Ecology - O.D.C.A.R.F. numbers 2.2.1 A & B, 3.2.1, 4.2.1 A & B, 5.2.1
- Sublethal Effects of Dumping - O.D.C.A.R.F. numbers, 8.2.1
- Oxygen Budget Studies - O.D.C.A.R.F. numbers 2.2.4, 3.2.6, 4.2.6, 4.2.7, 6.2.2.

### **Benthic Ecology**

Several studies under the scientific authority of C.D. Levings (D.F.O. West Vancouver Laboratory) examined the effects of dumping dredge spoils containing estuarine sediments and woodwaste on benthic biota. Water characteristics and the spatial and temporal distribution of benthic communities were examined at the dumpsite. There was no detectable effect on bottom water oxygen levels as a result of the dumping and previously reported seasonal trends were evident. Dumpsite sediments differed from control locations in containing more coarse material (ie: estuarine sediments originating at the dredge sites), lower organic content and higher C/N (carbon/nitrogen) ratios.

Although species diversity was reduced at the dumpsite, biomass was not significantly different over a one year sampling period. Rapid colonization between dumping events was measured with the most notable inhabitants being opportunistic polychaete species. Crustaceans, important prey animals for fish, were almost totally excluded from the dumpsite. The general conclusion from these studies was that the dumping of dredged material has a localized biological impact at the dumpsite. A more detailed discussion of these studies may be found in Levings et al., 1985.

### **Sublethal Effects of Dumping**

A research project was initiated in 1981 to determine whether or not the chemical constituents in dredge spoils deposited at the dumpsite were having sublethal effects on biota. W. Cretney and R. Macdonald (D.F.O. Institute of Ocean Sciences) provided the scientific authority guidance for the project. Samples from the dumpsite and reference areas were analysed for the trace metals cadmium, mercury and lead, the C/N ratios and the following organic compounds: polycyclic aromatic hydrocarbons (PAH's), polychlorinated biphenyls (PCB's) and pentachlorophenols (PCP's). Detailed histopathological studies were undertaken to assess the health and condition of three bivalve species and one polychaete species collected within and outside of the dump zone. The results suggested that the distribution and abundance of organisms in the dump zone was determined principally by a smothering effect and not by the distribution of chemicals in the sediments. Levels of cadmium, mercury and lead were not significantly different in the dump zone compared to adjacent areas. The concentrations of PAH's, PCB's and PCP's in Alberni Inlet and at the dumpsite were not abnormally high when compared to other locations.

### **Oxygen Budget Studies**

Disposal at the Port Alberni dumpsite of organic rich sediments with a high oxygen demand presented a potential oxygen depletion problem in inlet waters. W.H. Bell (D.F.O. Institute of Ocean Sciences) was the scientific authority on a project to identify oceanographic features existing in Alberni Inlet which might influence oxygen levels in the inlet. Studies provided evidence of an internal wave which resulted in fluctuating values for water quality parameters and made data interpretation difficult. There did however appear to be an annual flushing of the deep waters resulting in renewal of waters at the dumpsite. It was concluded that the water exchange would probably ensure that there would be no long term effects of organic rich material. A more detailed discussion of these studies may be found in Bell (1976).

#### MONITORING INFORMATION:

Benthic sediment surveys were collected in June 1980, March 1982, September 1983 and July 1986 (Figures 25, 26, and 27).

Cadmium levels found at the dumpsite (Tables 30, 31, 32, 33 and 34) are consistent with concentrations found throughout the inlet (0.7 - 1.7 ug/g).

In D.O.E. core surveys in 1984 and 1986 (on file), cadmium concentrations in excess of O.D.C.A. scheduled criteria (up to 1.3 ug/g) are found to 170 cm. of sediment depth as far away as Trevor Channel, approximately 20 nautical miles from the dumpsite.

Zinc levels at the dumpsite (153 - 393 ug/g) are significantly higher than the background levels determined in D.O.E. core surveys 1984 and 1986 (on file). The zinc is assumed to originate from the discharge of Alpulp bioponds solids in 1982 and earlier pulpmill discharges which contained zinc-based brightening compounds.

Trends at the dumpsite are difficult to interpret in that benthic sediments are impacted by sand and gravels from adjacent creeks and by wood debris and woodwastes from booming and storage areas in the vicinity.

A Pisces IV dive was completed in the dumpsite vicinity in March 1977. Dive records indicate the bottom littered with logs, branches and wood debris from dumping activity and log booming. Eelpouts and ratfish were only fauna noted near area of concentrated dumping (Petrie and Holman, 1983).



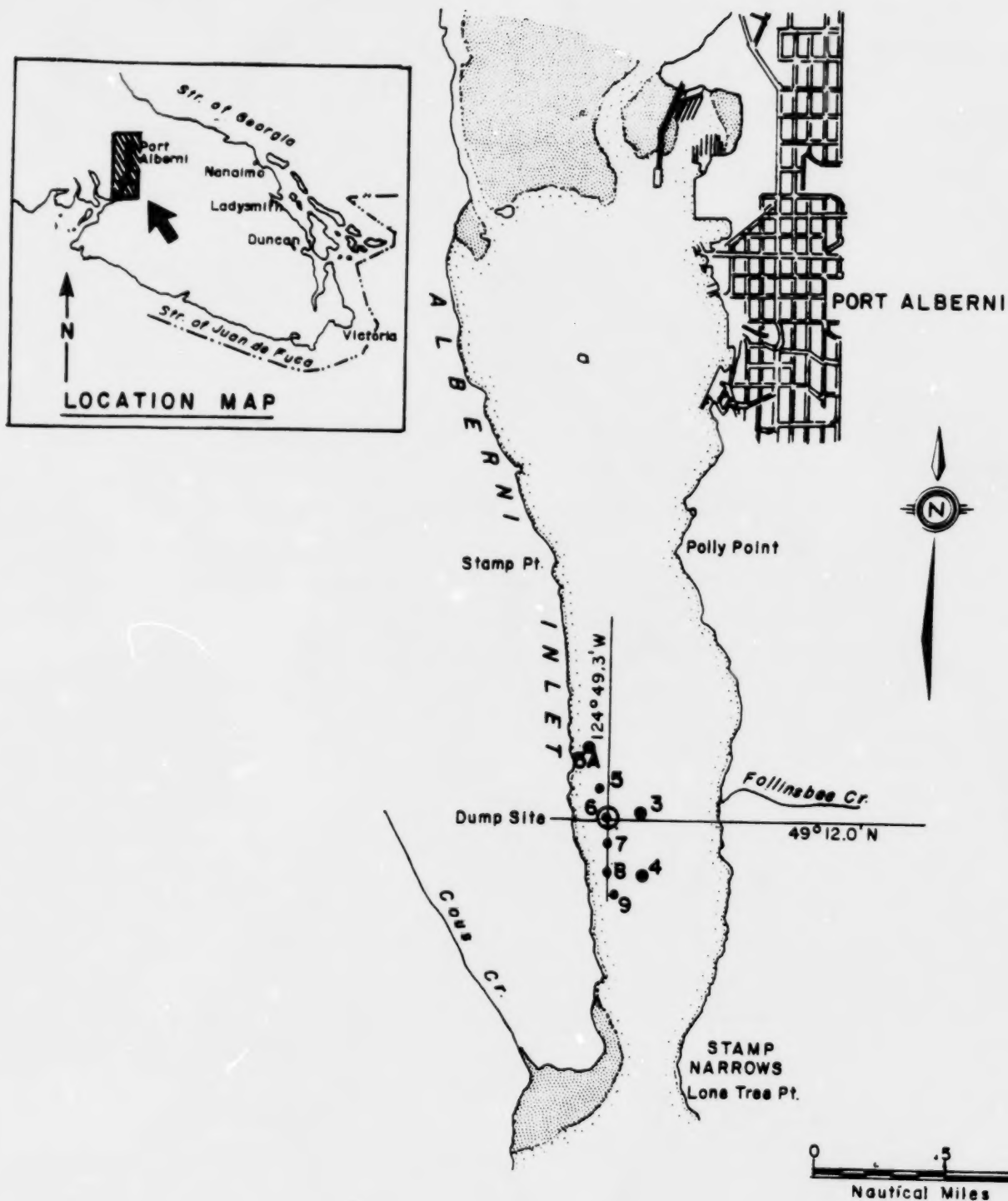


FIGURE 25

PORT ALBERNI OCEAN DUMPSITE - BENTHIC  
SEDIMENT SAMPLING STATIONS

**TABLE 30** PORT ALBERNI OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - GRAB AND CORE SAMPLES - JUNE 1980

| STATION  | Hg    | Cd           | Pb   | Cu   | Zn   |
|----------|-------|--------------|------|------|------|
| 1        | 0.441 | N.D. (.56)** | 67.5 | 65.5 | 270  |
| 2        | 0.363 | N.D. (.56)   | 65.5 | 72.5 | 246  |
| 3        | 0.535 | 1.22         | 64.0 | 66.0 | 323  |
| 4        | 0.637 | 0.90         | 59.5 | 52.0 | 575  |
| 5        |       |              |      |      |      |
| 0-12 cm  | 0.606 | 2.25         | 60.0 | 68.5 | 570  |
| 25-35 cm | 0.573 | 1.06         | 55.0 | 58.0 | 184  |
| 6        |       |              |      |      |      |
| 0-12 cm  | 0.432 | 0.89         | 69.0 | 58.0 | 280  |
| 25-35 cm | 1.030 | 1.23         | 59.5 | 56.5 | 575  |
| 7        | 0.312 | 0.78         | 56.5 | 57.2 | 98.5 |
| 8        | 0.645 | 0.96         | 53.5 | 47.4 | 396  |
| 9        | 0.543 | 1.27         | 56.0 | 56.5 | 370  |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection



TABLE 31 PORT ALBERNI OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - GRAB SAMPLES - MARCH 1982

| STATION | Hg   | Cd  | Pb   | Cu   | Zn   |
|---------|------|-----|------|------|------|
| 5       | 0.43 | 1.6 | 16.0 | 68.1 | 199  |
| 6       | 0.53 | 4.4 | 17.0 | 71.1 | 225. |
| 7       | 0.61 | 1.5 | 18.0 | 56.8 | 309. |
| 8       | 0.59 | 1.6 | 16.0 | 66.9 | 250. |
| 9       | 0.38 | 1.5 | 27.0 | 66.3 | 234. |

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\* All results expressed in ug/g dry weight

**TABLE 32** PORT ALBERNI OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB SAMPLES - SEPTEMBER 1983

| STATION | Hg        | Cd      | Pb   | Cu       | Zn     |
|---------|-----------|---------|------|----------|--------|
| 3       | 0.26      | 1.6     | 7    | 70.2     | 219    |
|         | 0.29      | 1.7     | 6    | 72.8     | 219    |
|         | 0.27      | 1.5     | 5    | 66.2     | 219    |
|         | 0.27+0.02 | 1.6+0.1 | 6+1  | 69.7+3.3 | 219+0  |
|         |           |         |      |          |        |
| 4       | 0.37      | 1.6     | 13   | 64.3     | 260    |
|         | 0.31      | 1.2     | 8    | 63.2     | 249    |
|         | 0.35      | 1.3     | 9    | 62.7     | 284    |
|         | 0.34+0.03 | 1.4+0.2 | 10+3 | 63.4+0.8 | 264+18 |
|         |           |         |      |          |        |
| 5       | 0.20      | 0.9     | 5    | 53.6     | 176    |
|         | 0.18      | 0.7     | 3    | 54.5     | 153    |
|         | 0.20      | 1.0     | 6    | 50.9     | 194    |
|         | 0.19+0.01 | 0.9+0.2 | 5+2  | 53.0+1.9 | 174+21 |
|         |           |         |      |          |        |
| 5A      | 0.26      | 1.2     | 8    | 58.3     | 257    |
|         | 0.22      | 1.3     | 7    | 61.5     | 255    |
|         | 0.14      | 0.9     | 4    | 50.1     | 180    |
|         | 0.21+0.06 | 1.1+0.2 | 6+2  | 56.6+5.9 | 231+44 |
|         |           |         |      |          |        |
| 6       | 0.30      | 1.5     | 9    | 65.5     | 393    |
|         | 0.27      | 1.5     | 8    | 60.9     | 356    |
|         | 0.27      | 1.4     | 9    | 59.9     | 373    |
|         | 0.28+0.02 | 1.5+0.1 | 9+1  | 62.1+3.0 | 374+19 |
|         |           |         |      |          |        |
| 7       | 0.24      | 1.5     | 5    | 61.2     | 289    |
|         | 0.26      | 1.5     | 8    | 62.3     | 309    |
|         | 0.23      | 1.3     | 9    | 60.5     | 300    |
|         | 0.24+0.02 | 1.4+0.1 | 8+2  | 61.3+0.9 | 299+10 |
|         |           |         |      |          |        |
| 8       | 0.25      | 1.5     | 8    | 66.9     | 265    |
|         | 0.24      | 1.5     | 6    | 66.8     | 267    |
|         | 0.23      | 1.6     | 6    | 66.5     | 288    |
|         | 0.24+0.01 | 1.5+0.1 | 7+1  | 66.7+0.2 | 273+13 |
|         |           |         |      |          |        |

\*All results expressed in ug/g dry weight

TABLE 32 (Continued)

| STATION   | Hg              | Cd                | Pb                | Cu                   | Zn                |
|-----------|-----------------|-------------------|-------------------|----------------------|-------------------|
| MESS-1    |                 |                   |                   |                      |                   |
| Certified | 0.17 $\pm$ 0.01 | 0.59 $\pm$ 0.01   | 34.0 $\pm$ 6.1    | 25.1 $\pm$ 3.8       | 191 $\pm$ 17      |
| Found     | 0.21            | 0.9<br>0.8        | 29<br>27          | 22.1<br>23.6         | 176<br>179        |
| BCSS-1    |                 |                   |                   |                      |                   |
| Certified | 0.13 $\pm$ 0.01 | 0.25 $\pm$ 0.04   | 22.7 $\pm$ 3.4    | 18.5 $\pm$ 2.7       | 119 $\pm$ 12      |
| Found     | 0.13            | 0.5<br>0.5<br>0.5 | 18.<br>20.<br>19. | 16.1<br>23.8<br>15.9 | 117<br>108<br>112 |

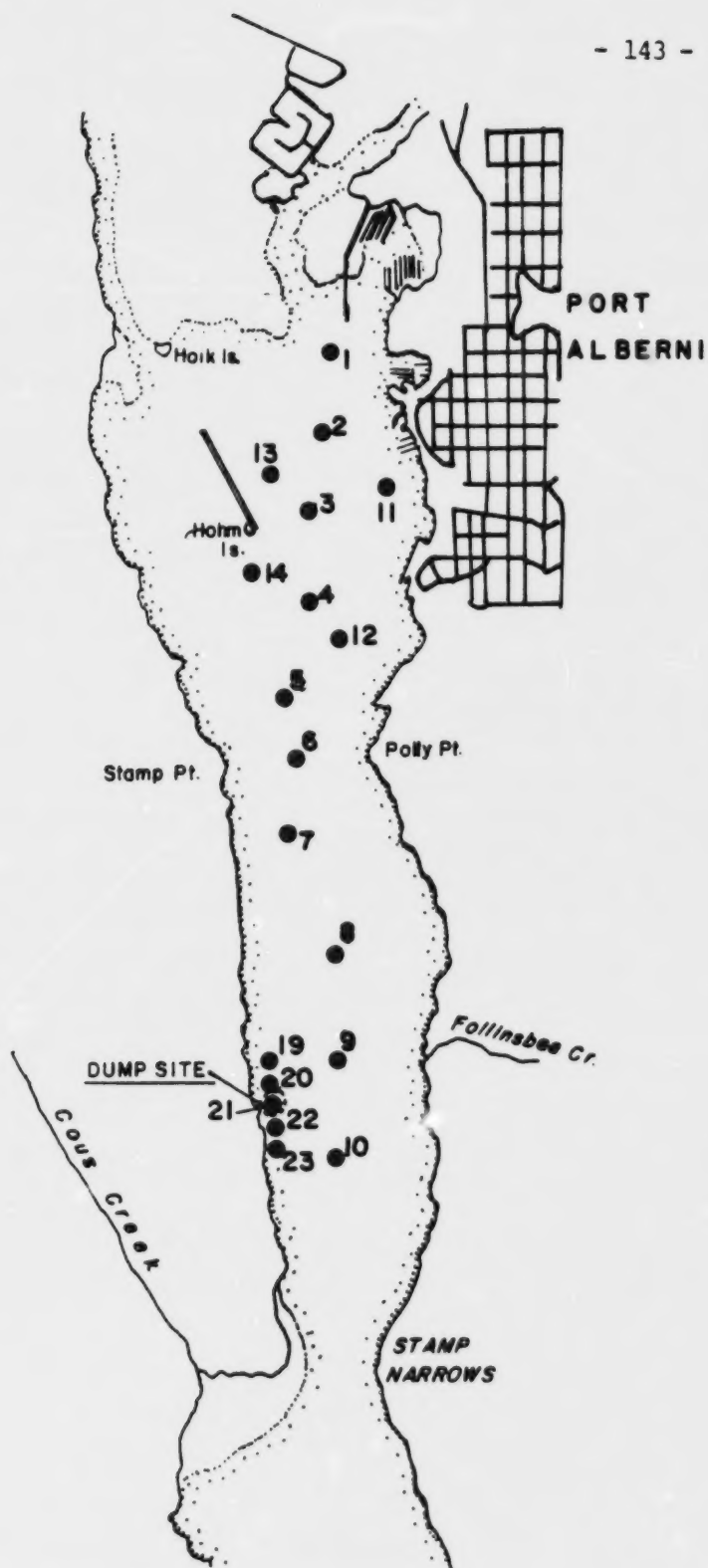
\*All results expressed in ug/g dry weight

**TABLE 33** PORT ALBERNI OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - CORE SAMPLES - SEPTEMBER 1983

| STATION   | Hg                  | Cd        | Pb        | Cu       | Zn     |
|-----------|---------------------|-----------|-----------|----------|--------|
| 3         |                     |           |           |          |        |
| 0-10 cm   | 0.29                | 1.5       | 9.        | 68.0     | 210.   |
| 30-40 cm  | 0.13                | 1.2       | N.D.(3)** | 73.8     | 92.3   |
| 60-70 cm  | 0.12                | 1.2       | N.D.(3)   | 69.5     | 85.9   |
| 4         |                     |           |           |          |        |
| 0-10 cm   | 0.26                | 1.3       | 5.        | 73.9     | 192.   |
| 30-40 cm  | 0.18                | 1.1       | N.D.(3)   | 71.9     | 119.   |
| 60-70 cm  | 0.13                | 1.4       | N.D.(3)   | 77.6     | 94.    |
| 5A        | .....NO SAMPLE..... |           |           |          |        |
| 5         | .....NO SAMPLE..... |           |           |          |        |
| 6         |                     |           |           |          |        |
| 0-10 cm   | 0.34                | 1.1       | 9.        | 54.9     | 300    |
| 30-40 cm  | 0.60                | 1.1       | 10.       | 55.2     | 639    |
| 7         | .....NO SAMPLE..... |           |           |          |        |
| 8         |                     |           |           |          |        |
| 0-10 cm   | 0.40                | 1.4       | 6.        | 61.1     | 319    |
| 30-40 cm  | 0.13                | 1.1       | N.D.(3)   | 73.3     | 93.8   |
| 60-70 cm  | 0.12                | 1.2       | N.D.(3)   | 76.5     | 91.7   |
| MESS-1    |                     |           |           |          |        |
| Certified | 0.17+0.01           | 0.59+0.1  | 34.0+6.1  | 25.1+3.8 | 191+17 |
| Found     | 0.21                | 0.6       | 30.       | 23.2     | 178    |
|           |                     | 0.7       | 29.       | 22.2     | 173    |
|           |                     | 0.8       | 27.       | 22.4     | 181    |
| BCSS-1    |                     |           |           |          |        |
| Certified | 0.13+0.01           | 0.25+0.04 | 22.7+3.4  | 18.5+2.7 | 119+12 |
| Found     | 0.14                | N.D.(.3)  | 21        | 15.8     | 114    |
|           |                     | 0.5       | 19        | 15.1     | 103    |
|           |                     | 0.4       | 18        | 14.8     | 106    |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection



0 1 2 3 4 5 10  
Nautical Miles

FIGURE 26 ALBERNI INLET - BENTHIC SEDIMENT SAMPLING STATIONS - July 1986

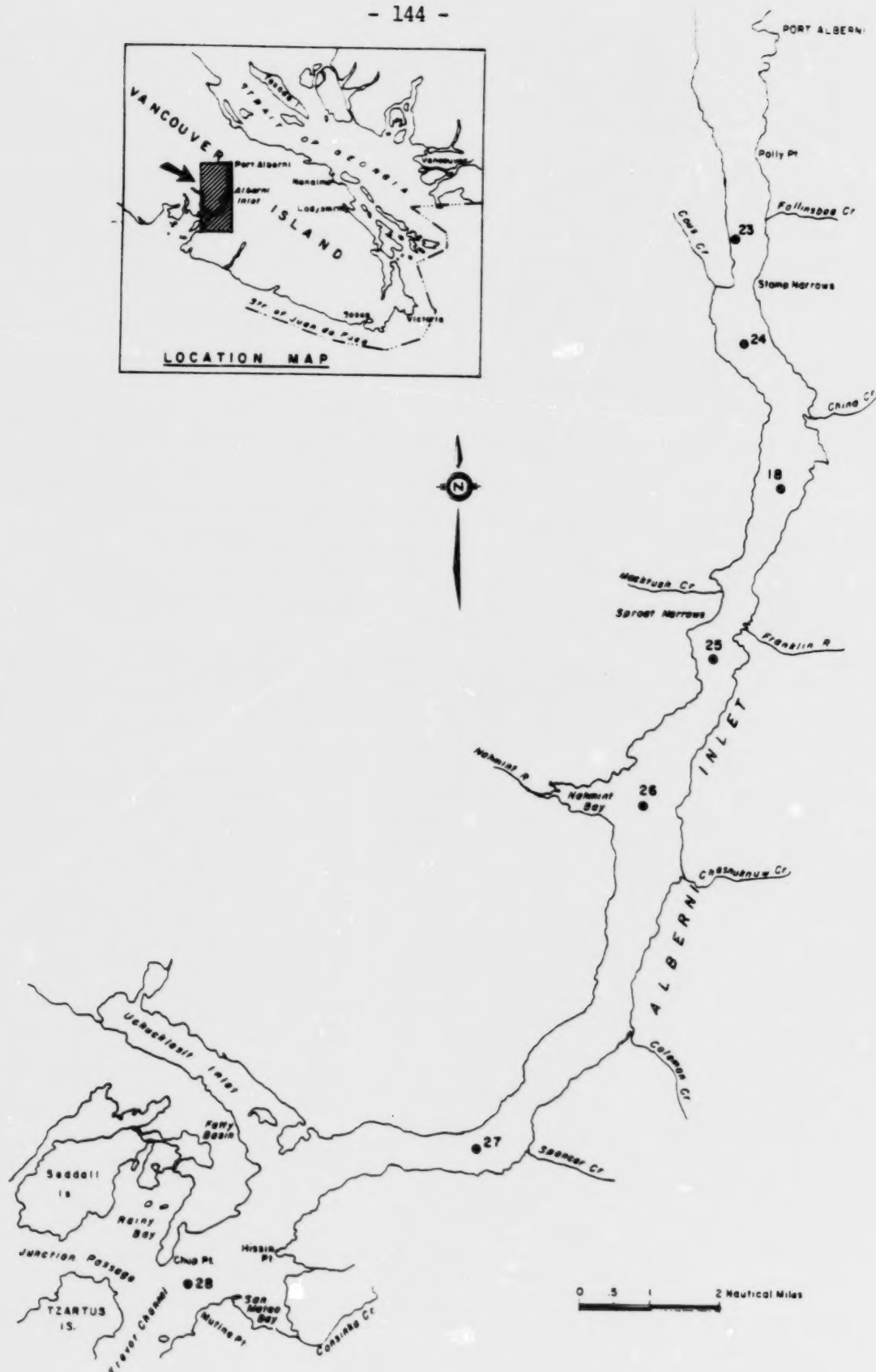


FIGURE 27

ALBERNI INLET - BENTHIC SEDIMENT SAMPLING  
STATIONS - July 1986

**TABLE 34** PORT ALBERNI OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB AND CORE SAMPLES - JULY 1986

| STATION         | Hg                                             | Cd                                             | Pb                                  | Cu                                            | Zn                                       |
|-----------------|------------------------------------------------|------------------------------------------------|-------------------------------------|-----------------------------------------------|------------------------------------------|
| 1               | 0.16<br>0.28<br>0.15<br><u>0.20</u> $\pm$ 0.07 | 1.00<br>0.73<br>0.47<br><u>0.73</u> $\pm$ 0.27 | 29<br>33<br>29<br><u>30</u> $\pm$ 2 | 78.4<br>80.7<br>79.4<br><u>79.5</u> $\pm$ 1.2 | 131<br>140<br>134<br><u>135</u> $\pm$ 5  |
| 2               | 0.20<br>0.21<br>0.23<br><u>0.21</u> $\pm$ 0.02 | 0.95<br>0.79<br>0.65<br><u>0.80</u> $\pm$ 0.15 | 35<br>34<br>34<br><u>34</u> $\pm$ 1 | 75.4<br>89.2<br>90.8<br><u>85.1</u> $\pm$ 8.5 | 155<br>165<br>167<br><u>162</u> $\pm$ 6  |
| 2<br>(Depth-cm) |                                                |                                                |                                     |                                               |                                          |
| 30-40           | 0.41                                           | 0.61                                           | 32                                  | 82.1                                          | 492                                      |
| 55-62           | 0.14                                           | 0.28                                           | 32                                  | 73.2                                          | 782                                      |
| 3               | 0.38<br>0.43<br>0.43<br><u>0.41</u> $\pm$ 0.03 | 1.03<br>2.6<br>2.2<br><u>1.9</u> $\pm$ 0.8     | 30<br>40<br>42<br><u>37</u> $\pm$ 6 | 68.7<br>80.0<br>82.1<br><u>76.9</u> $\pm$ 7.2 | 268<br>302<br>321<br><u>297</u> $\pm$ 27 |
| 4               | 0.4<br>0.50<br>0.46<br><u>0.47</u> $\pm$ 0.03  | 1.22<br>10.0<br>1.96<br><u>4.39</u> $\pm$ 4.87 | 37<br>33<br>32<br><u>34</u> $\pm$ 3 | 78.2<br>74.2<br>71.0<br><u>74.5</u> $\pm$ 3.6 | 293<br>297<br>309<br><u>300</u> $\pm$ 8  |
| 4<br>(Depth-cm) |                                                |                                                |                                     |                                               |                                          |
| 30-40           | 0.25                                           | 1.21                                           | 19                                  | 58.2                                          | 87.4                                     |
| 60-70           | 0.30                                           | 1.12                                           | 27                                  | 60.8                                          | 88.7                                     |
| 90-100          | 0.28                                           | 3.4                                            | 27                                  | 64.4                                          | 90.3                                     |
| 115-122         | 0.25                                           | 1.27                                           | 25                                  | 68.8                                          | 93.4                                     |
| 5               | 0.40<br>0.45<br>0.43<br><u>0.43</u> $\pm$ 0.03 | 2.7<br>2.4<br>2.4<br><u>2.5</u> $\pm$ 0.2      | 37<br>43<br>47<br><u>42</u> $\pm$ 2 | 86.9<br>92.4<br>88.2<br><u>89.2</u> $\pm$ 2.9 | 250<br>237<br>239<br><u>242</u> $\pm$ 7  |

\* All results expressed as ug/g dry weight



TABLE 34 (Continued)

| STATION         | Hg                                             | Cd                                             | Pb                                  | Cu                                             | Zn                                       |
|-----------------|------------------------------------------------|------------------------------------------------|-------------------------------------|------------------------------------------------|------------------------------------------|
| 6               | 0.48<br>0.40<br>0.44<br><u>0.44</u> $\pm$ 0.04 | 5.0<br>1.0<br>1.38<br><u>2.5</u> $\pm$ 2.2     | 34<br>35<br>33<br><u>34</u> $\pm$ 1 | 82.0<br>79.0<br>79.2<br><u>80.1</u> $\pm$ 1.7  | 229<br>240<br>228<br><u>232</u> $\pm$ 7  |
| 6<br>(Depth-cm) |                                                |                                                |                                     |                                                |                                          |
| 30-40           | 0.23                                           | 0.96                                           | 15                                  | 56.4                                           | 91.7                                     |
| 60-70           | 0.19                                           | 1.13                                           | 12                                  | 49.7                                           | 82.2                                     |
| 90-100          | 0.11                                           | 0.68                                           | 12                                  | 43.8                                           | 65.7                                     |
| 7               | 0.36<br>0.37<br>0.39<br><u>0.37</u> $\pm$ 0.02 | 0.86<br>0.82<br>2.2<br><u>1.29</u> $\pm$ 0.79  | 28<br>35<br>36<br><u>33</u> $\pm$ 4 | 72.8<br>73.1<br>82.8<br><u>76.2</u> $\pm$ 5.7  | 182<br>190<br>212<br><u>195</u> $\pm$ 16 |
| 8               | 0.36<br>0.38<br>0.42<br><u>0.39</u> $\pm$ 0.03 | 1.64<br>1.41<br>1.39<br><u>1.48</u> $\pm$ 0.14 | 28<br>34<br>30<br><u>31</u> $\pm$ 3 | 80.7<br>83.7<br>78.7<br><u>81.0</u> $\pm$ 2.5  | 210<br>227<br>223<br><u>220</u> $\pm$ 9  |
| 8<br>(Depth-cm) |                                                |                                                |                                     |                                                |                                          |
| 30-40           | 0.21                                           | N.D. (0.08)**                                  | 17                                  | 64.1                                           | 92.5                                     |
| 60-70           | 0.18                                           | 0.40                                           | 19                                  | 63.1                                           | 90.1                                     |
| 9               | 0.33<br>0.39<br>0.41<br><u>0.38</u> $\pm$ 0.04 | 1.26<br>1.43<br>1.52<br><u>1.40</u> $\pm$ 0.13 | 33<br>28<br>26<br><u>29</u> $\pm$ 4 | 86.2<br>82.4<br>82.3<br><u>83.6</u> $\pm$ 2.2  | 222<br>239<br>229<br><u>230</u> $\pm$ 9  |
| 9<br>(Depth-cm) |                                                |                                                |                                     |                                                |                                          |
| 30-40           | 0.20                                           | 0.55                                           | 18                                  | 73.3                                           | 111                                      |
| 60-70           | 0.17                                           | 0.81                                           | 11                                  | 70.3                                           | 101                                      |
| 90-100          | 0.18                                           | N.D. (0.08)                                    | 12                                  | 69.4                                           | 99.5                                     |
| 115-122         | 0.19                                           | 0.93                                           | 22                                  | 80.1                                           | 101                                      |
| 10              | 0.37<br>0.38<br>0.43<br><u>0.39</u> $\pm$ 0.03 | 1.77<br>1.47<br>1.38<br><u>1.54</u> $\pm$ 0.20 | 25<br>23<br>37<br><u>28</u> $\pm$ 8 | 70.8<br>69.1<br>89.8<br><u>76.6</u> $\pm$ 11.5 | 253<br>236<br>274<br><u>254</u> $\pm$ 19 |

\* All results expressed as ug/g dry weight

\*\* Numbers in brackets are limits of detection

TABLE 34 (Continued)

| STATION          | Hg              | Cd              | Pb          | Cu             | Zn           |
|------------------|-----------------|-----------------|-------------|----------------|--------------|
| 10<br>(Depth-cm) |                 |                 |             |                |              |
| 30-40            | 0.22            | 0.63            | 27          | 86.8           | 104          |
| 60-70            | 0.19            | 0.71            | 26          | 85.1           | 101          |
| 90-100           | 0.17            | 0.71            | 27          | 84.4           | 101          |
| 11               | 0.26            | 1.11            | 34          | 95.5           | 185          |
|                  | 0.22            | 0.85            | 31          | 93.8           | 212          |
|                  | 0.89            | 0.85            | 40          | 101.0          | 210          |
|                  | $0.46 \pm 0.38$ | $0.94 \pm 0.15$ | $35 \pm 5$  | $96.8 \pm 3.8$ | $202 \pm 15$ |
| 12               | 0.39            | 0.19            | 35          | 96.4           | 264          |
|                  | 0.46            | 0.15            | 37          | 94.1           | 253          |
|                  | 0.39            | 0.65            | 34          | 88.8           | 247          |
|                  | $0.41 \pm 0.04$ | $0.33 \pm 0.28$ | $35 \pm 2$  | $93.1 \pm 3.9$ | $255 \pm 9$  |
| 13               | 0.23            | 2.5             | 41          | 87.5           | 199          |
|                  | 0.29            | 3.9             | 44          | 80.6           | 191          |
|                  | 0.28            | 2.3             | 39          | 82.5           | 183          |
|                  | $0.27 \pm 0.03$ | $2.9 \pm 0.9$   | $41 \pm 3$  | $83.5 \pm 3.6$ | $191 \pm 8$  |
| 14               | 0.50            | 1.62            | 46          | 99.6           | 274          |
|                  | 0.47            | 1.21            | 57          | 89.9           | 282          |
|                  | 0.44            | 1.03            | 37          | 80.8           | 249          |
|                  | $0.47 \pm 0.03$ | $1.29 \pm 0.30$ | $47 \pm 10$ | $90.1 \pm 9.4$ | $268 \pm 17$ |
| 18               | 0.38            | 2.6             | 36          | 117            | 194          |
|                  | 0.36            | 4.1             | 37          | 119            | 190          |
|                  | 0.42            | 5.1             | 32          | 113            | 215          |
|                  | $0.39 \pm 0.03$ | $3.9 \pm 1.3$   | $35 \pm 3$  | $116 \pm 3$    | $200 \pm 13$ |
| 18<br>(Depth-cm) |                 |                 |             |                |              |
| 30-40            | 0.23            | 2.6             | 24          | 99.8           | 104          |
| 60-70            | 0.19            | 2.1             | 19          | 92.9           | 104          |
| 19               | 0.38            | 1.12            | 25          | 72.5           | 245          |
|                  | 0.35            | 1.12            | 19          | 60.2           | 269          |
|                  | 0.38            | 1.19            | 29          | 68.8           | 212          |
|                  | $0.37 \pm 0.02$ | $1.14 \pm 0.04$ | $24 \pm 5$  | $67.2 \pm 6.3$ | $242 \pm 29$ |
| 19<br>(Depth-cm) |                 |                 |             |                |              |
| 30-40            | 0.29            | 0.67            | 25          | 70.5           | 103          |
| 60-70            | 0.21            | 0.76            | 17          | 64.4           | 91.6         |

\* All results expressed as ug/g dry weight

TABLE 34 (Continued)

| STATION          | Hg                                             | Cd                                             | Pb                                  | Cu                                            | Zn                                       |
|------------------|------------------------------------------------|------------------------------------------------|-------------------------------------|-----------------------------------------------|------------------------------------------|
| 20               | 0.37<br>0.48<br>0.45<br><u>0.43</u> $\pm$ 0.06 | 1.34<br>1.35<br>1.07<br><u>1.25</u> $\pm$ 0.16 | 33<br>34<br>32<br><u>33</u> $\pm$ 1 | 77.4<br>79.4<br>77.2<br><u>78.0</u> $\pm$ 1.2 | 298<br>313<br>268<br><u>293</u> $\pm$ 23 |
| 21               | 0.30<br>0.23<br>0.33<br><u>0.29</u> $\pm$ 0.05 | 2.3<br>1.05<br>1.55<br><u>1.63</u> $\pm$ 0.63  | 27<br>22<br>28<br><u>26</u> $\pm$ 3 | 69.7<br>58.5<br>71.5<br><u>66.6</u> $\pm$ 7   | 361<br>286<br>360<br><u>336</u> $\pm$ 43 |
| 21<br>(Depth-cm) |                                                |                                                |                                     |                                               |                                          |
| 30-40            | 0.38                                           | 0.72                                           | 24                                  | 49.5                                          | 493                                      |
| 60-70            | 0.20                                           | 0.93                                           | 29                                  | 80.3                                          | 105                                      |
| 22               | 0.40<br>0.47<br>0.49<br><u>0.45</u> $\pm$ 0.05 | 1.93<br>2.1<br>2.0<br><u>2.0</u> $\pm$ 0.1     | 30<br>29<br>31<br><u>30</u> $\pm$ 1 | 66.5<br>54.0<br>70.0<br><u>63.5</u> $\pm$ 8.4 | 615<br>727<br>700<br><u>681</u> $\pm$ 58 |
| 23               | 0.39<br>0.37<br>0.41<br><u>0.39</u> $\pm$ 0.02 | 2.4<br>2.3<br>1.7<br><u>2.1</u> $\pm$ 0.4      | 31<br>31<br>30<br><u>31</u> $\pm$ 1 | 64.8<br>60.7<br>61.9<br><u>62.5</u> $\pm$ 2.1 | 417<br>446<br>480<br><u>448</u> $\pm$ 32 |
| 23<br>(Depth-cm) |                                                |                                                |                                     |                                               |                                          |
| 20-28            | 0.23                                           | 0.8                                            | 21                                  | 47.9                                          | 182                                      |
| 24               | 0.44<br>0.46<br>0.42<br><u>0.44</u> $\pm$ 0.02 | 2.6<br>2.6<br>2.0<br><u>2.4</u> $\pm$ 0.3      | 27<br>23<br>16<br><u>22</u> $\pm$ 6 | 108<br>107<br>101<br><u>105</u> $\pm$ 4       | 212<br>218<br>211<br><u>214</u> $\pm$ 4  |
| 24<br>(Depth-cm) |                                                |                                                |                                     |                                               |                                          |
| 30-40            | 0.22<br>0.22<br>0.24                           | 1.15<br>1.23<br>1.31                           | 18<br>23<br>19                      | 102<br>88.5<br>94.8                           | 112<br>103<br>111                        |

\* All results expressed as ug/g dry weight

TABLE 34 (Continued)

| STATION          | Hg                                             | Cd                                             | Pb                                  | Cu                                            | Zn                                       |
|------------------|------------------------------------------------|------------------------------------------------|-------------------------------------|-----------------------------------------------|------------------------------------------|
| 25               | 0.36<br>0.39<br>0.40<br><u>0.38</u> $\pm$ 0.02 | 1.01<br>1.63<br>1.27<br><u>1.30</u> $\pm$ 0.31 | 39<br>24<br>30<br><u>31</u> $\pm$ 8 | 115<br>112<br>116<br><u>114</u> $\pm$ 2       | 143<br>169<br>161<br><u>158</u> $\pm$ 13 |
| 25<br>(Depth-cm) |                                                |                                                |                                     |                                               |                                          |
| 30-40            | 0.22                                           | 0.66                                           | 15                                  | 86.7                                          | 89.3                                     |
| 60-70            | 0.20                                           | 1.47                                           | 22                                  | 95.5                                          | 87.7                                     |
| 90-100           | 0.15                                           | 0.95                                           | 20                                  | 88.0                                          | 93.8                                     |
| 26               | 0.49<br>0.53<br>0.46<br><u>0.49</u> $\pm$ 0.04 | 1.87<br>1.88<br>3.40<br><u>2.38</u> $\pm$ 0.88 | 32<br>33<br>40<br><u>35</u> $\pm$ 4 | 81.0<br>85.4<br>87.2<br><u>84.5</u> $\pm$ 3.2 | 189<br>189<br>191<br><u>190</u> $\pm$ 1  |
| 26<br>(Depth-cm) |                                                |                                                |                                     |                                               |                                          |
| 30-40            | 0.20                                           | 1.70                                           | 33                                  | 74.2                                          | 109                                      |
| 60-70            | 0.16                                           | 1.40                                           | 13                                  | 59.2                                          | 116                                      |
| 90-100           | 0.16                                           | 1.70                                           | 25                                  | 73.2                                          | 114                                      |
| 27               | 0.21<br>0.26<br>0.25<br><u>0.24</u> $\pm$ 0.03 | 1.27<br>1.30<br>1.59<br><u>1.38</u> $\pm$ 0.18 | 36<br>48<br>40<br><u>41</u> $\pm$ 6 | 56.5<br>64.0<br>61.4<br><u>60.6</u> $\pm$ 3.8 | 140<br>146<br>164<br><u>150</u> $\pm$ 12 |
| 27<br>(Depth-cm) |                                                |                                                |                                     |                                               |                                          |
| 30-40            | 0.23                                           | 1.45                                           | 38                                  | 54.5                                          | 121                                      |
| 60-70            | 0.23                                           | 2.50                                           | 20                                  | 46.5                                          | 113                                      |
| 90-100           | 0.25                                           | 1.49                                           | 29                                  | 49.7                                          | 107                                      |
| 120-130          | 0.17                                           | 1.48                                           | 27                                  | 54.1                                          | 116                                      |
| 150-160          | 0.18                                           | 1.08                                           | 27                                  | 51.5                                          | 109                                      |
| 28               | 0.16<br>0.15<br>0.14<br><u>0.15</u> $\pm$ 0.01 | 1.63<br>1.09<br>1.01<br><u>1.24</u> $\pm$ 0.34 | 30<br>24<br>24<br><u>26</u> $\pm$ 3 | 45.5<br>43.0<br>43.2<br><u>43.9</u> $\pm$ 1.4 | 139<br>136<br>139<br><u>138</u> $\pm$ 2  |

\* All results expressed as ug/g dry weight

TABLE 34 (Continued)

| STATION          | Hg   | Cd   | Pb | Cu   | Zn  |
|------------------|------|------|----|------|-----|
| 28<br>(Depth-cm) |      |      |    |      |     |
| 30-40            | 0.11 | 1.31 | 14 | 34.3 | 103 |
| 60-70            | 0.08 | 1.18 | 15 | 37.8 | 111 |
| 90-100           | 0.09 | 1.47 | 19 | 38.7 | 112 |
| 120-130          | 0.08 | 1.37 | 22 | 40.8 | 110 |
| 150-160          | 0.09 | 0.98 | 24 | 40.8 | 110 |

Accuracy Data for Stations 1 - 7, 11 - 14

MESS-1

|           |                 |                 |              |                |              |
|-----------|-----------------|-----------------|--------------|----------------|--------------|
| Certified | 0.17 $\pm$ 0.01 | 0.59 $\pm$ 0.10 | 34 $\pm$ 6.1 | 25.1 $\pm$ 3.8 | 191 $\pm$ 17 |
| Found     | 0.23            | 0.56            | 39           | 26.7           | 188          |
|           | 0.22            | 0.56            | 39           | 26.3           | 187          |
|           | 0.23            | 0.56            | 40           | 27.4           | 192          |
|           | 0.22            | 0.59            | 43           | 26.5           | 194          |
|           | 0.21            | 0.55            | 36           | 24.8           | 181          |

BCSS-1

|           |                 |                 |                |                |              |
|-----------|-----------------|-----------------|----------------|----------------|--------------|
| Certified | 0.13 $\pm$ 0.01 | 0.25 $\pm$ 0.04 | 22.7 $\pm$ 3.4 | 18.5 $\pm$ 2.7 | 119 $\pm$ 12 |
| Found     | 0.17            | 0.20            | 31             | 18.9           | 116          |
|           | 0.19            | 0.23            | 31             | 18.0           | 115          |
|           | 0.17            | 0.21            | 32             | 17.3           | 112          |
|           | 0.19            | 0.24            | 30             | 18.0           | 118          |
|           | 0.16            | 0.22            | 30             | 16.9           | 117          |

Accuracy Data for Stations 8 - 10, 19 - 23

MESS-1

|           |                 |                 |              |                |              |
|-----------|-----------------|-----------------|--------------|----------------|--------------|
| Certified | 0.17 $\pm$ 0.01 | 0.59 $\pm$ 0.10 | 34 $\pm$ 6.1 | 25.1 $\pm$ 3.8 | 191 $\pm$ 17 |
| Found     | 0.26            | 0.58            | 38           | 22.5           | 191          |
|           | 0.21            | 0.60            | 41           | 23.0           | 195          |
|           | 0.20            | 0.58            | 47           | 24.9           | 197          |
|           | 0.21            | 0.61            | 44           | 26.3           | 195          |
|           | 0.21            | 0.55            | 42           | 25.5           | 188          |

\* All results expressed as ug/g dry weight

TABLE 34 (Continued)

| STATION                                                      | Hg              | Cd              | Pb             | Cu             | Zn           |
|--------------------------------------------------------------|-----------------|-----------------|----------------|----------------|--------------|
| <u>Accuracy Data for Stations 1 - 7, 11 - 14 (continued)</u> |                 |                 |                |                |              |
| BCSS-1                                                       |                 |                 |                |                |              |
| Certified                                                    | 0.13 $\pm$ 0.01 | 0.25 $\pm$ 0.04 | 22.7 $\pm$ 3.4 | 18.5 $\pm$ 2.7 | 119 $\pm$ 12 |
| Found                                                        | 0.15            | 0.22            | 32             | 15.5           | 116          |
|                                                              | 0.16            | 0.23            | 30             | 16.0           | 117          |
|                                                              | 0.15            | 0.24            | 28             | 14.7           | 112          |
|                                                              | 0.15            | 0.23            | 25             | 13.9           | 111          |
|                                                              | 0.15            | 0.22            | 27             | 14.3           | 109          |
| <u>Accuracy Data for Stations 18, 24 - 28</u>                |                 |                 |                |                |              |
| MESS-1                                                       |                 |                 |                |                |              |
| Certified                                                    | 0.17 $\pm$ 0.01 | 0.59 $\pm$ 0.10 | 34.0 $\pm$ 6.1 | 25.1 $\pm$ 3.8 | 191 $\pm$ 17 |
| Found                                                        | 0.22            | 0.63            | 39             | 25.7           | 195          |
|                                                              | 0.21            | 0.63            | 44             | 27.5           | 192          |
|                                                              | 0.20            | 0.63            | 41             | 26.0           | 197          |
|                                                              | 0.23            | 0.66            | 39             | 27.4           | 202          |
|                                                              | 0.22            | 0.64            | 42             | 24.9           | 200          |
| BCSS-1                                                       |                 |                 |                |                |              |
| Certified                                                    | 0.13 $\pm$ 0.01 | 0.25 $\pm$ 0.04 | 22.7 $\pm$ 3.4 | 18.5 $\pm$ 2.7 | 119 $\pm$ 12 |
| Found                                                        | 0.13            | 0.23            | 35             | 16.7           | 117          |
|                                                              | 0.16            | 0.25            | 32             | 17.5           | 119          |
|                                                              | 0.14            | 0.23            | 33             | 17.0           | 116          |
|                                                              | 0.16            | 0.25            | 31             | 16.0           | 116          |
|                                                              | 0.17            | 0.25            | 26             | 16.0           | 114          |

\* All results expressed as ug/g dry weight  
 \*\*Numbers in brackets are limits of detection

DUMPSITE: MUCHALAT INLET  
NUMBER: 117  
CO-ORDINATES: 49°39.00'N 126°14.90'W  
DEPTH: 370 metres  
TOTAL QUANTITY  
DUMPED: 108 965 cubic metres  
LOADSITE INFORMATION:

Refer to discussion for Tahsis Inlet dump site (no. 83).

**RESEARCH INFORMATION:**

No research information available.

**MONITORING INFORMATION:**

Benthic sediment surveys were conducted in September 1981 and August 1984 (Figure 28).

High cadmium concentrations (0.15-3.2 ug/g) seem to be prevalent throughout the inlet, except at Station 13, at the head, which would be strongly influenced by stream and river-borne sediments, predominantly from the Gold River (Tables 35 and 36). In a single core in September 1981, cadmium concentrations appeared to increase with depth.

A Pisces IV dive was completed in March 1977. Dive records indicate a depauperate benthic community; only amphipods were observed. This is in part due to the depth at the dumpsite (340 metres) and also to the fiber deposition originating from the adjacent pulpmill outfall (Petrie and Holman, 1983).



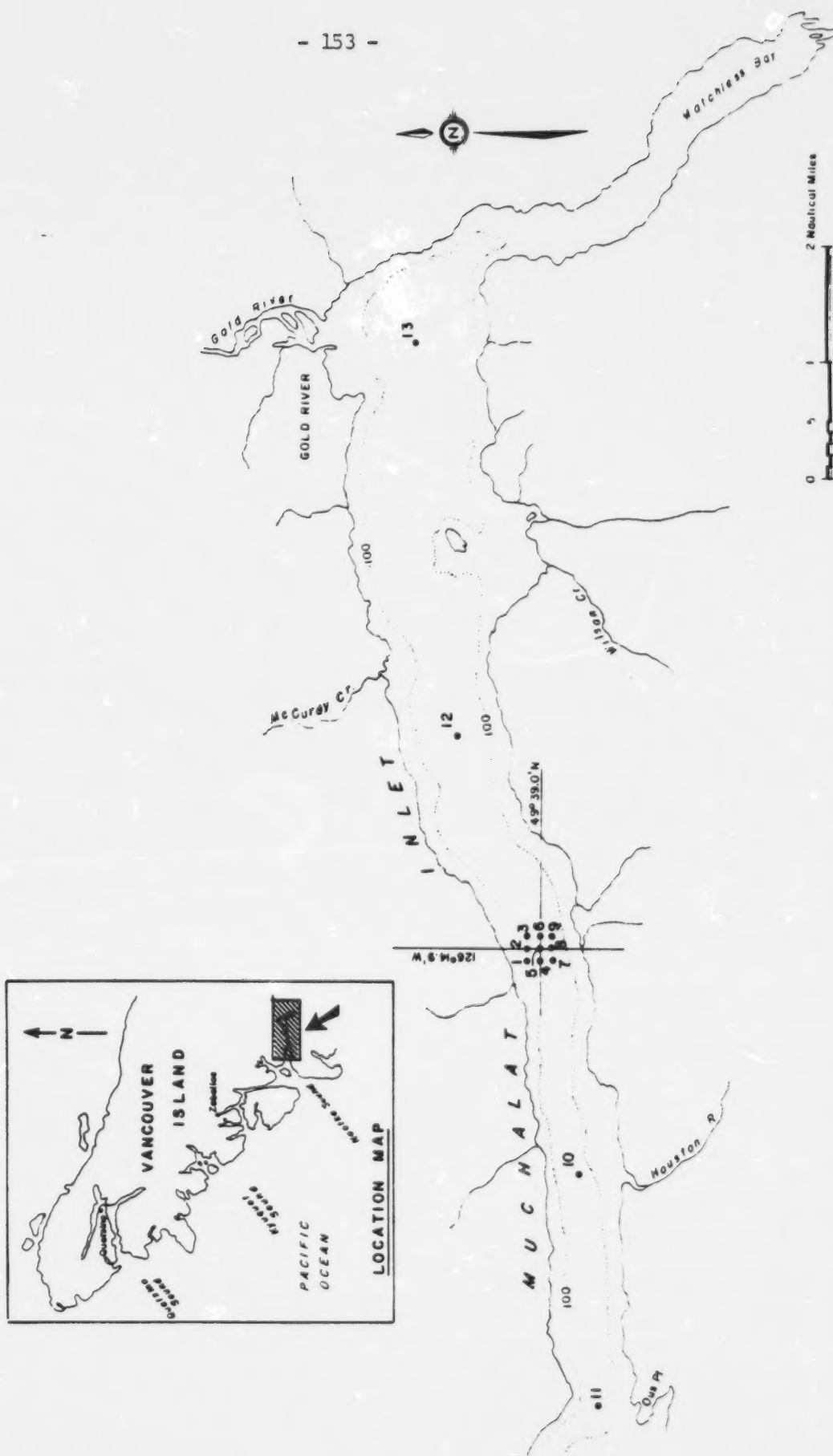


FIGURE 28 MUCHALAT INLET OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

**TABLE 35** MUCHALAT INLET OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - GRAB AND CORE SAMPLES - SEPTEMBER 1981

| STATION    | Hg    | Cd    | Pb   | Cu   | Zn   |
|------------|-------|-------|------|------|------|
| 1          | 0.305 | 1.1   | 7.45 | 50.8 | 60.8 |
| 2          | 0.264 | 0.907 | 9.66 | 56.4 | 65.4 |
| 3          | 1.020 | 1.02  | 8.54 | 69.7 | 59.7 |
| 4          | 0.175 | 1.46  | 8.54 | 59.0 | 69.0 |
| 5          |       |       |      |      |      |
| 0-10 cm    | 0.269 | 1.37  | 9.27 | 57.9 | 70.3 |
| 30-36 cm   | 0.389 | 1.52  | 11.0 | 60.4 | 63.9 |
| 60-65 cm   | 0.524 | 2.62  | 10.8 | 51.7 | 69.1 |
| 105-110 cm | 0.900 | 2.85  | 9.6  | 54.1 | 67.3 |
| 6          | 0.311 | 0.90  | 11.1 | 55.0 | 58.9 |
| 7          | 0.305 | 0.99  | 12.9 | 62.9 | 62.0 |
| 8          | 0.607 | 1.26  | 12.1 | 53.8 | 63.2 |
| 9          | 0.311 | 2.79  | 10.2 | 51.1 | 69.7 |

\* All results expressed in ug/g dry weight

**TABLE 36** MUCHALAT INLET OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB SAMPLES - AUGUST 1984

| STATION | Hg                                       | Cd                | Pb           | Cu               | Zn               |
|---------|------------------------------------------|-------------------|--------------|------------------|------------------|
| MI-1    | 0.135                                    | 1.70              | 9            | 71.5             | 98.7             |
|         | 0.124                                    | 1.58              | 7            | 70.5             | 89.7             |
|         | 0.143                                    | 1.59              | 7            | 73.3             | 89.0             |
|         | <u>0.134</u> +0.01                       | <u>1.62</u> +0.07 | <u>8</u> +1  | <u>71.8</u> +1.4 | <u>92.5</u> +5.4 |
|         |                                          |                   |              |                  |                  |
| MI-2    | 0.173                                    | 2.45              | 8            | 66.8             | 107              |
|         | 0.190                                    | 1.95              | 9            | 61.1             | 101              |
|         | 0.158                                    | 2.25              | 9            | 65.1             | 103              |
|         | <u>0.174</u> +0.016                      | <u>2.22</u> +0.25 | <u>9</u> +1  | <u>64.3</u> +2.9 | <u>104</u> +3    |
|         |                                          |                   |              |                  |                  |
| MI-3    | 0.182                                    | 1.00              | 13           | 76.4             | 100              |
|         | 0.183                                    | 1.84              | 13           | 73.6             | 104              |
|         | 0.192                                    | 1.67              | 13           | 67.2             | 103              |
|         | <u>0.186</u> +0.006                      | <u>1.50</u> +0.40 | <u>13</u> +0 | <u>72.4</u> +4.7 | <u>102</u> +2    |
|         |                                          |                   |              |                  |                  |
| MI-4    | 0.180                                    | 2.2               | 11           | 74.6             | 114              |
|         | 0.178                                    | 3.2               | 11           | 68.8             | 105              |
|         | 0.173                                    | 1.6               | 8            | 63.8             | 96.3             |
|         | <u>0.177</u> +0.004                      | <u>2.3</u> +0.8   | <u>10</u> +2 | <u>69.1</u> +5.4 | <u>105</u> +1    |
|         |                                          |                   |              |                  |                  |
| MI-5    | NO SEDIMENT SAMPLE - WOOD BARK AND CHIPS |                   |              |                  |                  |
| MI-6    | 0.121                                    | 0.91              | 5            | 76.0             | 82.7             |
|         | 0.133                                    | 1.60              | 6            | 77.1             | 86.9             |
|         | 0.133                                    | 0.91              | 8            | 78.5             | 86.7             |
|         | <u>0.129</u> +0.007                      | <u>1.14</u> +0.40 | <u>6</u> +2  | <u>77.2</u> +1.3 | <u>85.4</u> +2.4 |
|         |                                          |                   |              |                  |                  |
| MI-7    | 0.208                                    | 3.1               | 11           | 68.8             | 102              |
|         | 0.196                                    | 1.6               | 12           | 69.9             | 102              |
|         | 0.179                                    | 3.2               | 10           | 70.3             | 102              |
|         | <u>0.194</u> +0.015                      | <u>2.6</u> +0.9   | <u>11</u> +1 | <u>69.7</u> +0.8 | <u>102</u> +0    |
|         |                                          |                   |              |                  |                  |
| MI-8    | 0.188                                    | 3.10              | 8            | 72.6             | 103              |
|         | 0.204                                    | 0.15              | 6            | 69.6             | 100              |
|         | 0.197                                    | 1.09              | 9            | 66.3             | 95.0             |
|         | <u>0.196</u> +0.008                      | <u>1.45</u> +1.51 | <u>8</u> +2  | <u>69.5</u> +3.2 | <u>99</u> +4     |
|         |                                          |                   |              |                  |                  |
| MI-9    | 0.179                                    | 0.61              | 16           | 71.2             | 96.4             |
|         | 0.180                                    | 0.76              | 11           | 73.9             | 103              |
|         | 0.194                                    | 0.81              | 11           | 74.3             | 108              |
|         | <u>0.184</u> +0.008                      | <u>0.73</u> +0.10 | <u>13</u> +3 | <u>73.1</u>      | <u>103</u> +6    |
|         |                                          |                   |              |                  |                  |

\* All results expressed in ug/g dry weight

TABLE 36 (Continued)

| STATION   | Hg                                                  | Cd                                             | Pb                                 | Cu                                            | Zn                                          |
|-----------|-----------------------------------------------------|------------------------------------------------|------------------------------------|-----------------------------------------------|---------------------------------------------|
| MI-10     | 0.276<br>0.217<br>0.234<br><u>0.242</u> $\pm$ 0.030 | 0.89<br>1.10<br>0.89<br><u>0.96</u> $\pm$ 0.12 | 9<br>10<br>9<br><u>9</u> $\pm$ 1   | 58.5<br>55.8<br>56.2<br><u>56.8</u> $\pm$ 1.5 | 109<br>104<br>107<br><u>107</u> $\pm$ 3     |
| MI-11     | 0.178<br>0.217<br>0.196<br><u>0.197</u> $\pm$ 0.020 | 1.44<br>1.10<br>1.16<br><u>1.23</u> $\pm$ 0.18 | 10<br>12<br>9<br><u>10</u> $\pm$ 2 | 48.6<br>57.9<br>46.4<br><u>51.0</u> $\pm$ 6.1 | 102<br>111<br>97.9<br><u>104</u> $\pm$ 7    |
| MI-12     | 0.169<br>0.160<br>0.200<br><u>0.176</u> $\pm$ 0.021 | 0.84<br>1.52<br>-<br><u>1.18</u> $\pm$ 0.48    | 9<br>9<br>9<br><u>9</u> $\pm$ 0    | 71.4<br>71.2<br>71.6<br><u>71.4</u> $\pm$ 0.2 | 100<br>102<br>100<br><u>101</u> $\pm$ 1     |
| MI-13     | 0.056<br>0.084<br>0.059<br><u>0.066</u> $\pm$ 0.015 | 0.21<br>0.31<br>0.26<br><u>0.26</u> $\pm$ 0.05 | **N.D.(3)<br>N.D.(3)<br>N.D.(3)    | 83.2<br>89.7<br>80.0<br><u>84.3</u> $\pm$ 4.9 | 58.3<br>62.2<br>59.5<br><u>60.0</u> $\pm$ 2 |
| MESS-1    |                                                     |                                                |                                    |                                               |                                             |
| Certified | 0.171 $\pm$ 0.014                                   | 0.59 $\pm$ 0.10                                | 34 $\pm$ 6.1                       | 25.1 $\pm$ 3.8                                | 191 $\pm$ 17                                |
| Found     | 0.185<br>0.200<br>0.187<br>-<br>-<br>-              | 0.48<br>0.49<br>0.50<br>-<br>-<br>-            | 28<br>27<br>27<br>34<br>27<br>28   | 24.5<br>23.1<br>23.5<br>27.5<br>25.3<br>23.3  | 189<br>173<br>182<br>209<br>185<br>176      |
| BCSS-1    |                                                     |                                                |                                    |                                               |                                             |
| Certified | 0.129 $\pm$ 0.012                                   | 0.25 $\pm$ 0.04                                | 22.7 $\pm$ 3.4                     | 18.5 $\pm$ 2.7                                | 119 $\pm$ 12                                |
| Found     | 0.131<br>0.143<br>0.149<br>-<br>-                   | 0.27<br>0.28<br>0.28<br>-<br>-                 | 19<br>19<br>19<br>21<br>19         | 16.2<br>16.8<br>16.2<br>16.6<br>16.1          | 109<br>118<br>110<br>113<br>112             |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

DUMPSITE: ELIZA PASSAGE  
NUMBER: 118  
CO-ORDINATES: 49°40.80'N 126°34.30'W  
DEPTH: 200 metres  
TOTAL QUANTITY:  
DUMPED: 5 430 cubic metres.  
LOADSITE INFORMATION:

Refer to discussion for Tahsis Inlet dump site (no. 83).

**RESEARCH INFORMATION:**

No research information available.

**MONITORING INFORMATION:**

Benthic sediment surveys were conducted in September 1981 and August 1984 (Figure 29).

Background cadmium levels at this location are in excess of O.D.C.A. scheduled criteria (0.49 - 1.87 ug/g) (Tables 37 and 38). In a single core taken in August 1984, high cadmium concentrations appear to be consistent with depth.

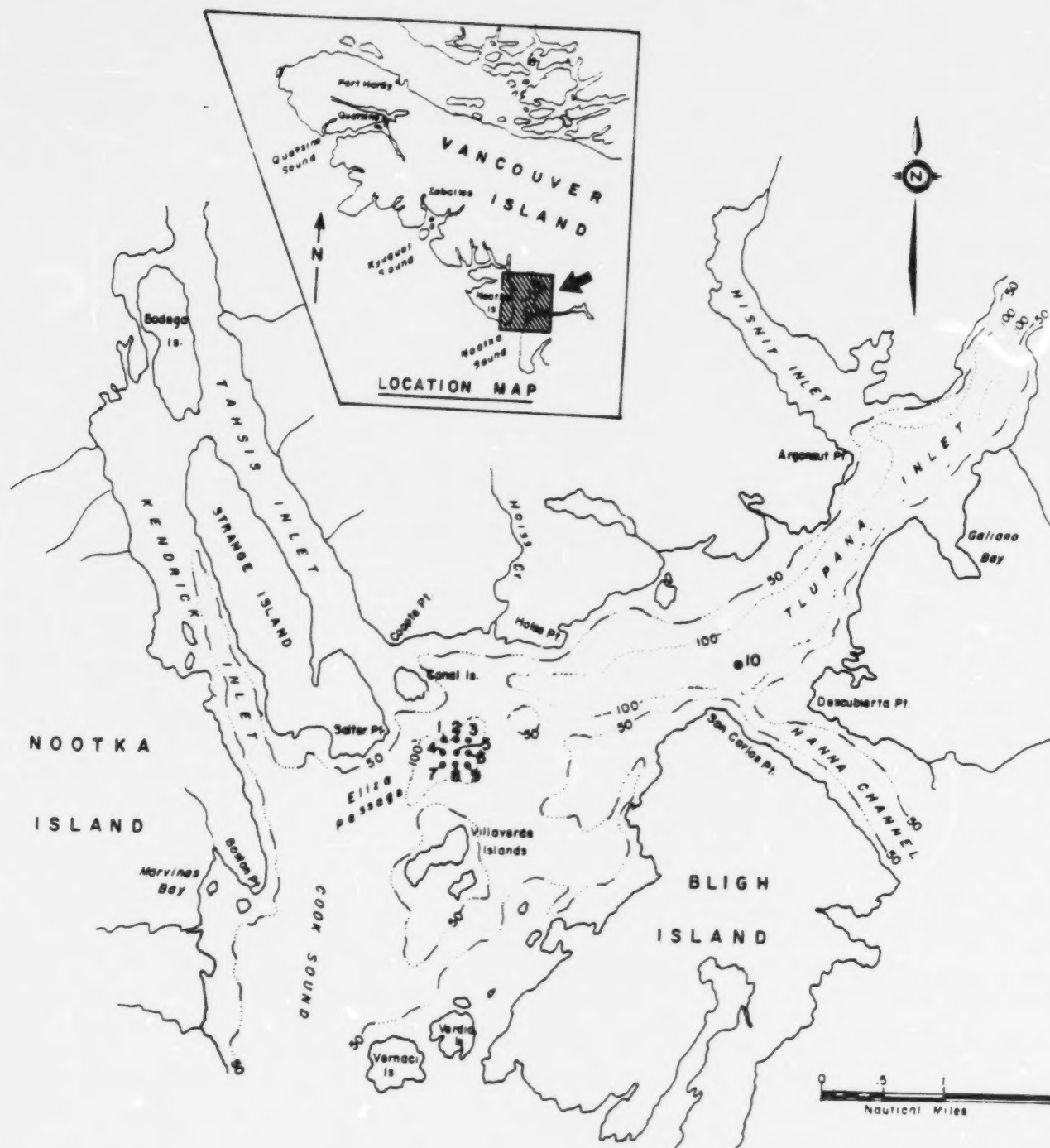


FIGURE 29 ELIZA PASSAGE OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

**TABLE 37** ELIZA PASSAGE OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - GRAB AND CORE SAMPLES - SEPTEMBER 1981

| STATION    | Hg          | Cd         | Pb   | Cu   | Zn   |
|------------|-------------|------------|------|------|------|
| 1          | 0.246       | N.D. (.66) | 16.1 | 36.6 | 84.4 |
| 2          | 0.316       | N.D. (.66) | 15.8 | 35.3 | 79.2 |
| 3          | N.D. (.200) | 1.20       | 15.8 | 38.4 | 81.1 |
| 4          | N.D. (.200) | N.D. (.66) | 15.5 | 37.7 | 81.4 |
| 5          |             |            |      |      |      |
| 0-5 cm     | N.D. (.185) | N.D. (.66) | 14.1 | 45.1 | 84.5 |
| 65-70 cm   | N.D. (.167) | 1.63       | 9.8  | 40.0 | 74.5 |
| 120-130 cm | N.D. (.172) | 1.17       | 8.9  | 41.1 | 76.5 |
| 6          | 0.323       | N.D. (.66) | 16.6 | 36.9 | 83.8 |
| 7          | N.D. (.200) | N.D. (.66) | 13.4 | 33.0 | 70.2 |
| 8          | 0.254       | N.D. (.66) | 16.2 | 37.1 | 82.6 |
| 9          | 0.316       | N.D. (.66) | 18.0 | 38.4 | 84.7 |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection



**TABLE 38** ELIZA PASSAGE OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB AND CORE SAMPLES - AUGUST 1984

| STATION         | Hg                                             | Cd                                        | Pb                             | Cu                                       | Zn                                       |
|-----------------|------------------------------------------------|-------------------------------------------|--------------------------------|------------------------------------------|------------------------------------------|
| EP-1            | 0.186<br>0.209<br>0.185<br><u>0.193</u> +0.014 | 0.78<br>0.88<br>0.77<br><u>0.81</u> +0.06 | 15<br>17<br>15<br><u>16</u> +1 | 47.8<br>54.6<br>43.0<br><u>48.5</u> +5.8 | 97.9<br>110<br>90.6<br><u>99.5</u> +9.8  |
| EP-2            | 0.102<br>0.112<br>0.102<br><u>0.105</u> +0.006 | 0.52<br>1.32<br>0.49<br><u>0.78</u> +0.47 | 6<br>6<br>6<br><u>6</u> +0     | 33.6<br>31.9<br>30.1<br><u>31.9</u> +1.8 | 56.7<br>56.4<br>55.5<br><u>56.2</u> +0.6 |
| EP-3            | 0.226<br>0.172<br>0.191<br><u>0.196</u> +0.027 | 0.76<br>0.85<br>0.83<br><u>0.81</u> +0.05 | 17<br>15<br>16<br><u>16</u> +1 | 49.7<br>46.6<br>50.2<br><u>48.8</u> +2.0 | 97.8<br>99.1<br>101<br><u>99.3</u> +1.6  |
| EP-4            | 0.201<br>0.203<br>0.196<br><u>0.200</u> +0.004 | 0.81<br>0.73<br>1.05<br><u>0.86</u> +0.17 | 17<br>15<br>15<br><u>16</u> +1 | 52.2<br>44.8<br>46.2<br><u>47.7</u> +3.9 | 104<br>93.6<br>99.0<br><u>98.9</u> +5.2  |
| EP-5            | 0.178<br>0.184<br>0.183<br><u>0.182</u> +0.003 | 1.01<br>0.96<br>0.94<br><u>0.97</u> +0.04 | 16<br>14<br>15<br><u>15</u> +1 | 45.7<br>47.3<br>46.2<br><u>46.4</u> +0.8 | 93.4<br>93.9<br>96.8<br><u>94.7</u> +1.8 |
| EP-5<br>1-10 cm | 0.270                                          | 0.88                                      | 9                              | 51.8                                     | 98.7                                     |
| 30-40 cm        | 0.182                                          | 1.11                                      | 10                             | 43.3                                     | 91.9                                     |
| 60-70 cm        | 0.148                                          | 0.60                                      | 3                              | 39.4                                     | 85.4                                     |
| EP-6            | 0.181<br>0.248<br>0.212<br><u>0.214</u> +0.034 | 0.91<br>0.83<br>0.86<br><u>0.87</u> +0.04 | 18<br>17<br>15<br><u>17</u> +2 | 47.8<br>50.8<br>48.3<br><u>49.0</u> +1.6 | 97.4<br>98.5<br>96.2<br><u>97.4</u> +1.2 |

\* All results expressed in ug/g dry weight

TABLE 38 (Continued)

| STATION | Hg                                             | Cd                                        | Pb                               | Cu                                           | Zn                                      |
|---------|------------------------------------------------|-------------------------------------------|----------------------------------|----------------------------------------------|-----------------------------------------|
| EP-7    | 0.194<br>0.178<br>0.200<br><u>0.191</u> +0.011 | 0.91<br>0.64<br>0.60<br><u>0.72</u> +0.17 | 15<br>16<br>18<br><u>16</u> +2   | 46.3<br>47.8<br>49.4<br><u>47.8</u> +1.6     | 96.7<br>100<br>96.7<br><u>97.8</u> +1.9 |
| EP-8    | 0.209<br>0.213<br>0.184<br><u>0.201</u> +0.016 | 0.86<br>0.87<br>1.82<br><u>1.18</u> +0.55 | 18<br>18<br>33<br><u>23</u> +9   | 50.9<br>47.8<br>121<br><u>73.2</u> +41.4     | 106<br>100<br>328<br><u>178</u> +130    |
| EP-9    | 0.214<br>0.240<br>0.262<br><u>0.239</u> +0.024 | 0.83<br>0.91<br>0.94<br><u>0.89</u> +0.06 | 17<br>15<br>15<br><u>16</u> +1   | 47.9<br>51.8<br>48.5<br><u>49.4</u> +2.1     | 97.3<br>101<br>99.0<br><u>99.1</u> +1.9 |
| EP-10   | 0.212<br>0.229<br>0.213<br><u>0.218</u> +0.01  | 0.56<br>0.89<br>1.01<br><u>0.82</u> +0.23 | 16<br>14<br>17<br><u>16</u> +2   | 51.0<br>50.1<br>55.0<br><u>52.0</u> +2.6     | 105<br>100<br>106<br><u>104</u> +3      |
| MESS-1  |                                                |                                           |                                  |                                              |                                         |
| Cert.   | <u>0.171</u> +0.014                            | 0.59 ± 0.10                               | <u>34</u> +6.1                   | 25.1 ± 3.8                                   | 191 ± 17                                |
| Found   | 0.185<br>0.200<br>0.187<br>-<br>-<br>-         | 0.48<br>0.49<br>0.50<br>-<br>-<br>-       | 28<br>27<br>27<br>34<br>27<br>28 | 24.5<br>23.1<br>23.5<br>27.5<br>25.3<br>23.3 | 189<br>173<br>182<br>209<br>185<br>176  |
| BCSS-1  |                                                |                                           |                                  |                                              |                                         |
| Cert.   | <u>0.129</u> +0.12                             | 0.25 ± 0.04                               | <u>22.7</u> +3.4                 | 18.5 ± 2.7                                   | 119 ± 12                                |
| Found   | 0.131<br>0.143<br>0.149<br>-<br>-              | 0.27<br>0.28<br>0.28<br>-<br>-            | 19<br>19<br>19<br>21<br>19       | 16.2<br>16.8<br>16.2<br>16.6<br>16.1         | 109<br>118<br>110<br>113<br>112         |

\* All results expressed in ug/g dry weight

\*\* Numbers in brackets are limits of detection

DUMPSITE: JOHNSTONE STRAIT (HICKEY POINT)  
NUMBER: 119  
CO-ORDINATES: 50°27.80'N 126°04.80'W  
DEPTH: 270 metres  
TOTAL QUANTITY  
DUMPED: 111 075 cubic metres  
LOADSITE INFORMATION:

The Johnstone Strait (Hickey Point) dump site was designated in 1980 at the request of MacMillan Bloedel (M & B) to service two of the Companies operations. The dump site is located in the southern part of the Strait between M & B's Eve River log dump and the Kelsey Bay water sorting facility at the mouth of the Salmon River. Dredge spoils from both locations contain river sediments (silt, sand, gravel) and woodwastes. Chemical analysis of samples over the years have given no indication of contamination and the relatively strong currents at the dump site would preclude any significant build-up of woodwastes. In 1983, M & B dumped a 40 tonne piece of scrap metal from an old steel hull being used in a breakwater at the Kelsey Bay operation.

The Department of Fisheries and Oceans prefers that dredging/loading activities be conducted during late winter or mid-summer to avoid conflicts with salmon migration in and around the nearby streams and rivers.

**RESEARCH INFORMATION:**

No research information available.

DUMPSITE: JOHNSTONE STRAIT (HANSON ISLAND)  
NUMBER: 120  
CO-ORDINATES: 50°33.50'N 126°48.00'W  
DEPTH: 470 metres  
TOTAL QUANTITY  
DUMPED: 209 032 cubic metres  
COMMENTS:

Site inactive. Material for ocean disposal directed to Malcolm Island dumpsite effective March 1, 1985.

**LOADSITE INFORMATION:**

The Johnstone Strait (Hanson Island) dumpsite is located at the north end of Johnstone Strait about 3 kilometres north east of Beaver Cove. The site was designated in 1980 to accommodate the disposal of mud and woodwastes from the Crown Zellerbach (CZ) log dump in Beaver Cove under O.D.C.A. file number - 01005. The disposal of wastes from this operation into shallow waters of Beaver Cove rather than at the designated site led to the Federal government laying charges under the O.D.C.A. in B.C. Provincial Court. The contention by the CZ lawyer that the O.D.C.A. was constitutionally invalid in Provincial waters was upheld by the B.C. Supreme Court. Environment Canada subsequently lost an appeal in the B.C. Appeals Court (January 1984) and is currently awaiting a decision on the case from the Supreme Court of Canada. This decision is expected sometime in 1987.

There is a commercial salmon fishery in the vicinity of the dumpsite. D.F.O. generally restricted dumping operations to periods which would not interfere with the gillnet and seine fishery. Loading/dredging activities in Beaver Cove, Port McNeill and Sointula (Malcolm Island) were generally carried out in winter months to avoid conflict with fishery resources.

The dumpsite was first used in 1983 for disposal of about 19 000 cubic metres of silt, sand and gravel from Port McNeill Harbour to extend docking facilities. The harbour and MacMillan Bloedel's (M&B) log storage

and booming grounds at Port McNeill were both sampled in 1983 for chemical analysis. No contamination was reported. In 1984, 20 000 cubic metres of clay, gravel and woodwaste from the M & B site were dumped. Public Works Canada dredged in Sointula boat harbour between October 1983 and February 1984 removing 75 000 cubic metres of mud, sand and gravel for disposal at the site.

In 1983, R.O.D.A.C. was asked to consider establishing a new dumpsite in the area owing to concerns from SCUBA divers that siltation from dumping could adversely impact on valued marine habitat nearby. At the time, the Provincial government was considering the protection of Weynton Passage as an Ecological Reserve. In 1984, M & B requested an alternative site for their Port McNeill dredge spoils to avoid towing problems due to the strong tidal currents and adverse weather conditions experienced in Johnstone Strait, especially during winter months. Although R.O.D.A.C. did not feel that dumping would impact on Weynton Passage they designated a new dumpsite (see No. 121, Malcolm Island) in September 1984 which was closer to Port McNeill and in more protected waters. The new site was established with the understanding that dumping at the Johnstone Strait (Hanson Island) site would cease on March 1, 1985.

#### RESEARCH INFORMATION:

No research information available.

#### MONITORING INFORMATION:

An attempt to collect sediment samples in November 1982 was unsuccessful owing to rock and cobble substrate at the dumpsite location (Figure 30) (Table 39).

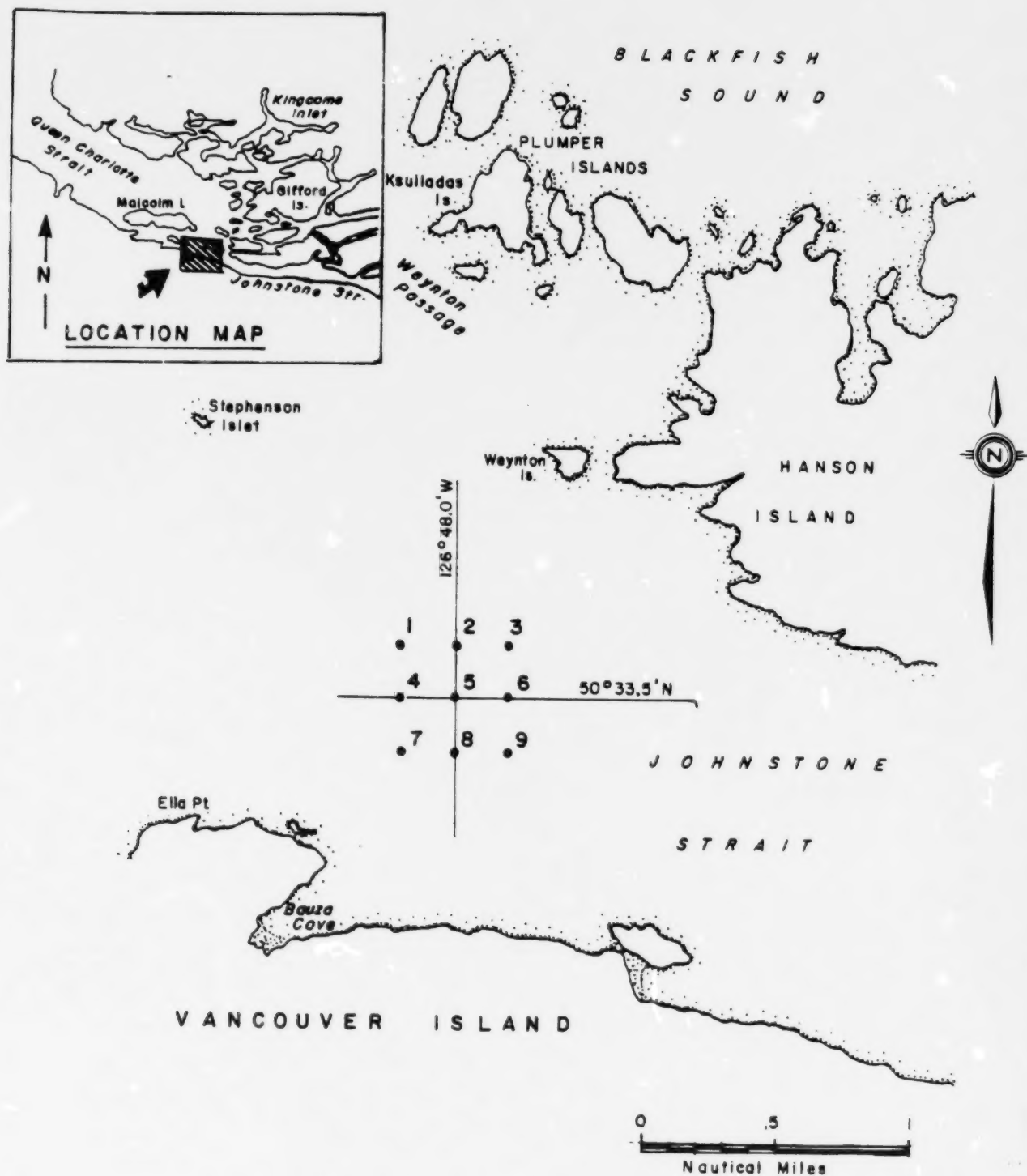


FIGURE 30 JOHNSTONE STRAIT - HANSON ISLAND OCEAN DUMPSITE  
BENTHIC SEDIMENT SAMPLING STATIONS

TABLE 39    JOHNSTONE STRAIT OCEAN DUMP SITE- TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - GRAB SAMPLES - NOVEMBER 1982

| STATION | Hg    | Cd         | Pb             | Cu    | Zn    |
|---------|-------|------------|----------------|-------|-------|
| 1       | ..... | .....      | NO SAMPLE..... | ..... | ..... |
| 2       | ..... | .....      | NO SAMPLE..... | ..... | ..... |
| 3       | ..... | .....      | NO SAMPLE..... | ..... | ..... |
| 4       | ..... | .....      | NO SAMPLE..... | ..... | ..... |
| 5       | ..... | .....      | NO SAMPLE..... | ..... | ..... |
| 6       | ..... | .....      | NO SAMPLE..... | ..... | ..... |
| 7       | ..... | .....      | NO SAMPLE..... | ..... | ..... |
| 8       | ..... | .....      | NO SAMPLE..... | ..... | ..... |
| 9       | 0.06  | N.D.(.3)** | N.D.(3)        | 63.9  | 88.9  |

\* All results expressed in ug/g dry weight

\*\* Numbers in brackets are limits of detection



DUMPSITE: MALCOLM ISLAND  
NUMBER: 121  
CO-ORDINATES: 50°42.00'N 126°06.00'W  
DEPTH: 180 metres  
TOTAL QUANTITY  
DUMPED: 95 180 cubic metres  
LOADSITE INFORMATION:

The Malcolm Island dumpsite was designated in September 1984 to replace the Johnstone Strait (Hanson Island) site. Please refer to the discussion for the latter site (No. 120) for loadsite concerns and fishery timing restrictions.

The Malcolm Island site was first used in November 1984 to dispose of 30 000 cubic metres of marine sediments and woodwastes from MacMillan Bloedel's log storage and booming grounds at Port McNeill. At about the same time, 46 000 cubic metres of similar material was removed from Western Forest Products booming grounds nearby. In 1985, Public Works Canada dumped 19 000 cubic metres of mostly sand and gravel removed from Port McNeill harbour to deepen the access channel to docking facilities. Previous sampling and analysis of sediments from the Port McNeill area did not indicate chemical contamination.

Crown Forest Industries in Beaver Cove presently have approval (O.D.C.A. file number -01814) to dredge and dump 10 000 cubic metres of mud and woodwastes from their log sorting facility in 1987.

**RESEARCH INFORMATION:**

No research information available.

**MONITORING INFORMATION:**

A benthic sediment survey was conducted in July 1985 (Figure 31). Trace metal concentrations were found in ranges comparable to normal background levels in the Strait of Georgia (Table 40).

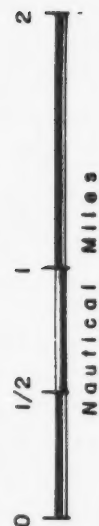
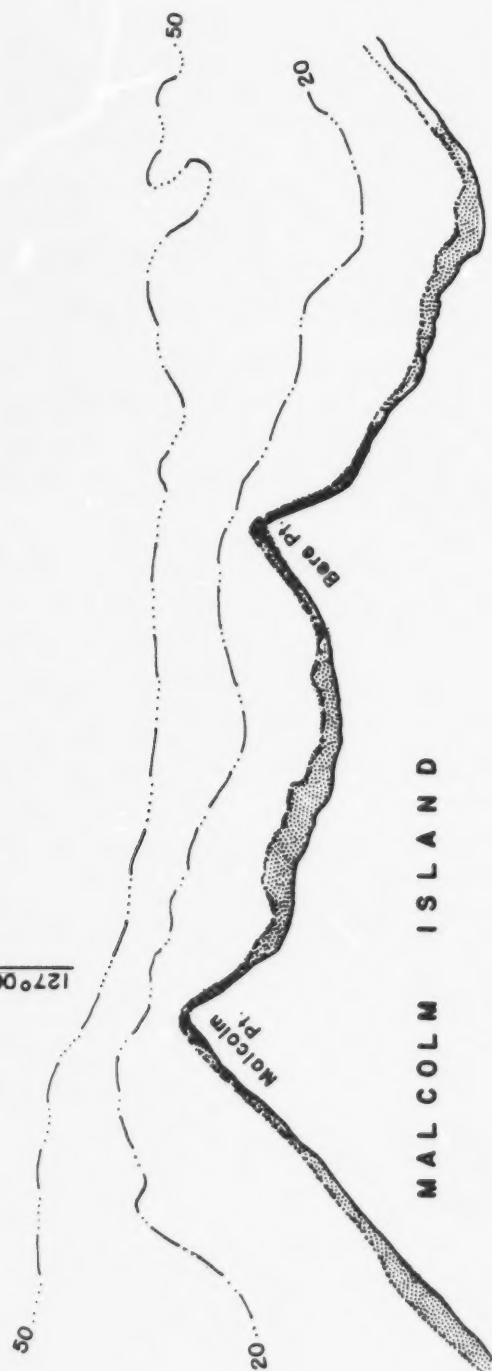
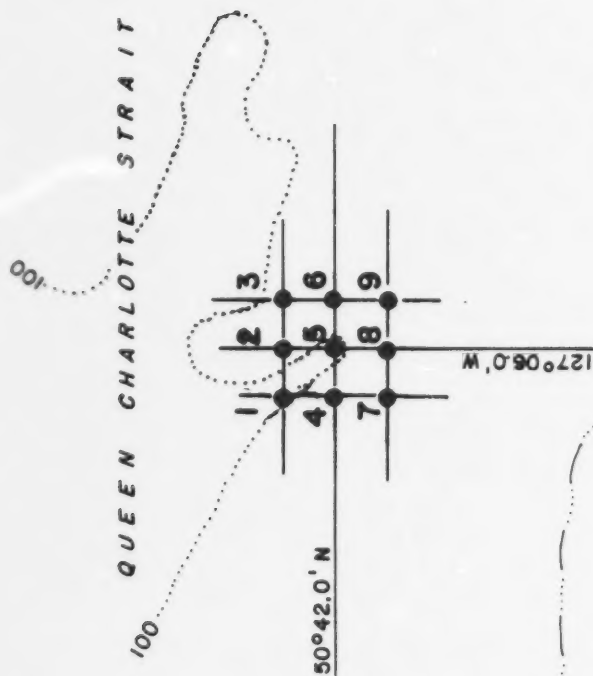
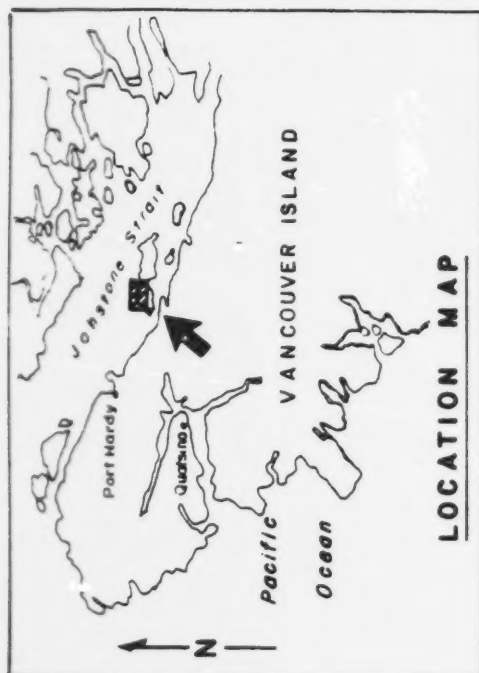


FIGURE 31 MALCOLM ISLAND OCEAN DUMPSITE - BENTHIC SEDIMENT SAMPLING STATIONS

**TABLE 40** MALCOLM ISLAND OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS WITH POPULATION MEAN AND POPULATION  
STANDARD DEVIATION - GRAB AND CORE SAMPLES - JULY 1985

| STATION     | Hg                                             | Cd                                             | Pb                               | Cu                                             | Zn                                            |
|-------------|------------------------------------------------|------------------------------------------------|----------------------------------|------------------------------------------------|-----------------------------------------------|
| 1           | 0.06<br>0.04<br>0.05<br><u>0.05</u> $\pm$ 0.01 | 0.12<br>0.11<br>0.14<br><u>0.12</u> $\pm$ 0.02 | N.D.(3)**<br>6<br>3<br>—         | 19.9<br>17.8<br>18.6<br><u>18.8</u> $\pm$ 1.06 | 47.9<br>38.5<br>41.8<br><u>42.7</u> $\pm$ 4.8 |
| 2           | 0.08<br>0.07<br>0.07<br><u>0.07</u> $\pm$ 0.01 | 0.61<br>0.59<br>0.56<br><u>0.59</u> $\pm$ 0.03 | 7<br>7<br>9<br><u>8</u> $\pm$ 1  | 23.0<br>22.5<br>22.2<br><u>22.6</u> $\pm$ 0.4  | 60.5<br>57.9<br>58.3<br><u>58.9</u> $\pm$ 1.4 |
| 3           | 0.07<br>0.07<br>0.07<br><u>0.07</u> $\pm$ 0    | 0.31<br>0.47<br>0.33<br><u>0.37</u> $\pm$ 0.09 | N.D.(3)<br>N.D.(3)<br>5<br>—     | 34.6<br>32.6<br>37.9<br><u>35.0</u> $\pm$ 2.7  | 80.2<br>74.8<br>79.0<br><u>84.7</u> $\pm$ 8.8 |
| 4           | 0.06<br>0.06<br>0.05<br><u>0.06</u> $\pm$ 0.01 | 0.19<br>0.22<br>0.17<br><u>0.19</u> $\pm$ 0.03 | 8<br>7<br>6<br><u>7</u> $\pm$ 1  | 20.0<br>19.9<br>18.8<br><u>19.6</u> $\pm$ 0.7  | 44.2<br>44.8<br>40.8<br><u>43.3</u> $\pm$ 2.2 |
| 5           | 0.09<br>0.07<br>0.07<br><u>0.08</u> $\pm$ 0.01 | 0.64<br>0.67<br>0.68<br><u>0.66</u> $\pm$ 0.02 | 7<br>8<br>10<br><u>8</u> $\pm$ 2 | 23.2<br>23.3<br>20.2<br><u>22.2</u> $\pm$ 1.8  | 59.9<br>56.9<br>57.8<br><u>58.2</u> $\pm$ 1.5 |
| 5<br>(Core) |                                                |                                                |                                  |                                                |                                               |
| (10-15 cm)  | 0.07                                           | 0.81                                           | 6                                | 20.5                                           | 54.7                                          |
| (20-25 cm)  | 0.07                                           | 0.82                                           | N.D.(3)                          | 20.4                                           | 54.8                                          |
| 6           | 0.10<br>0.09<br>0.10<br><u>0.10</u> $\pm$ 0.01 | 0.28<br>0.27<br>0.34<br><u>0.30</u> $\pm$ 0.04 | 12<br>8<br>10 $\pm$ 2<br>—       | 34.2<br>33.7<br>33.3<br><u>33.7</u> $\pm$ 0.5  | 73.8<br>63.7<br>71.7<br><u>69.7</u> $\pm$ 5.3 |
| 7           | 0.07<br>0.09<br>0.08<br><u>0.08</u> $\pm$ 0.01 | 0.29<br>0.38<br>0.38<br><u>0.35</u> $\pm$ 0.05 | 4<br>5<br>5 $\pm$ 1<br>—         | 25.9<br>26.4<br>26.3<br><u>26.2</u> $\pm$ 0.3  | 57.6<br>62.5<br>62.0<br><u>60.7</u> $\pm$ 2.7 |

\* All results expressed in ug/g dry weight

\*\* Numbers in brackets are limits of detection

TABLE 40 (Continued)

| STATION   | Hg              | Cd              | Pb         | Cu             | Zn             |
|-----------|-----------------|-----------------|------------|----------------|----------------|
| 8         | 0.08            | 0.66            | 6          | 25.0           | 64.8           |
|           | 0.08            | 0.62            | N.D.(3)**  | 24.7           | 63.5           |
|           | 0.07            | 0.82            | 6          | 23.4           | 62.9           |
|           | $0.08 \pm 0.01$ | $0.70 \pm 0.11$ |            | $24.4 \pm 0.9$ | $63.7 \pm 1.0$ |
|           |                 |                 |            |                |                |
| 9         | 0.06            | 0.27            | 8          | 22.0           | 43.7           |
|           | 0.05            | 0.23            | 6          | 22.7           | 43.9           |
|           | 0.06            | 0.24            | N.D.(3)    | 18.6           | 41.6           |
|           | $0.06 \pm 0.01$ | $0.25 \pm 0.02$ |            | $21.1 \pm 2.2$ | $43.1 \pm 1.3$ |
|           |                 |                 |            |                |                |
| 10        | 0.06            | 0.19            | 6          | 13.4           | 31.6           |
|           | 0.06            | 0.26            | 9          | 15.9           | 37.3           |
|           | 0.05            | 0.22            | 6          | 15.7           | 34.4           |
|           | $0.06 \pm 0.01$ | $0.22 \pm 0.04$ | $7 \pm 2$  | $15.0 \pm 1.4$ | $34.4 \pm 2.9$ |
|           |                 |                 |            |                |                |
| 11        | 0.07            | 0.28            | 9          | 28.0           | 58.9           |
|           | 0.06            | 0.21            | 6          | 20.4           | 50.7           |
|           | 0.05            | 0.23            | 5          | 19.1           | 44.2           |
|           | $0.06 \pm 0.01$ | $0.24 \pm 0.04$ | $7 \pm 2$  | $22.5 \pm 4.8$ | $51.2 \pm 7.4$ |
|           |                 |                 |            |                |                |
| MESS-1    |                 |                 |            |                |                |
| Certified | $0.17 \pm 0.01$ | $0.59 \pm 0.10$ | $34 \pm 6$ | $25.1 \pm 3.8$ | $191 \pm 17$   |
| Found     | 0.19            | 0.57            | 29         | 24.4           | 188            |
|           | 0.18            | 0.59            | 30         | 25.3           | 194            |
|           | 0.19            | 0.59            | 32         | 25.6           | 180            |
|           | 0.19            | 0.57            | 33         | 25.4           | 182            |
|           |                 | 0.59            | 28         | 24.7           | 182            |
| BCSS-1    |                 |                 |            |                |                |
| Certified | $0.13 \pm 0.01$ | $0.24 \pm 0.04$ | $23 \pm 3$ | $18.5 \pm 2.7$ | $119 \pm 12$   |
| Found     | 0.15            | 0.30            | 22         | 17.0           | 112            |
|           | 0.15            | 0.31            | 20         | 16.9           | 112            |
|           | 0.15            | 0.31            | 20         | 16.9           | 113            |
|           | 0.14            | 0.31            | 18         | 17.1           | 113            |
|           | 0.16            | 0.32            | 20         | 17.4           | 114            |

\* All results expressed in ug/g dry weight

\*\*Numbers in brackets are limits of detection

5.2.3 Queen Charlotte Islands and B.C. North Coast.

|                |                        |
|----------------|------------------------|
| DUMPSITE:      | <u>KITIMAT ARM</u>     |
| NUMBER:        | 93                     |
| CO-ORDINATES:  | 53°58.00'N 128°41.50'W |
| DEPTH:         | 176 metres             |
| TOTAL QUANTITY |                        |
| DUMPED:        | 63 455 cubic metres    |
| COMMENTS:      |                        |

Approximately 9,000 cubic metres of silt and wood debris was dumped at 53°59.30'N 128°41.20'W in January 1982.

LOADSITE INFORMATION:

The Kitimat Arm dumpsite, located about 3 kilometres from Kitimat, was designated in 1977. A submarine slide of the soft marine clay that forms a portion of the bottom sediments of Kitimat Arm was recorded in April, 1975 (Bell and Kallman, 1976). The instability of the bottom sediments in Kitimat Arm were a factor in the siting of the dump site.

Owing to a misunderstanding between Alcan Smelters and Chemicals Ltd. and the permit issuing office, material dredged in 1982 (9,000 cubic metres) was dumped just south of the dredge site at coordinates 53°59.3'N, 128°41.2'W. During the 1982 operation, material from loaded scows originating at Alcan's Terminal Wharf No. 1 was sampled for chemical analyses. One of four samples analysed for polychlorinated biphenyl showed a level of 1.5 ug/g. There was no other indication of contamination. In addition, it should be noted that in 1979, 27,000 cubic metres of dredged material, ODCA file numbers -00589 and -00593, (Ward and Sullivan, 1980) was disposed of at co-ordinates 53° 59.3'N, 128° 41.2'W.

Material dredged from the Terminal Wharf in 1986, under O.D.C.A. file number -01981, was the first to be disposed of at the Kitimat Arm dumpsite. The 4,800 cubic metres of spoils were comprised mainly of fine clay and silt infill from the Kitimat River. Although there were no timing restrictions on the 1986 project, the Department of Fisheries and Oceans may impose restrictions to protect fishery resources in the Kitimat estuary.

**RESEARCH INFORMATION:**

No research information available.

**MONITORING INFORMATION:**

A benthic sediment survey was completed in April 1982 (Figure 32).  
Trace metal concentrations are not of concern at this location (Table 41).



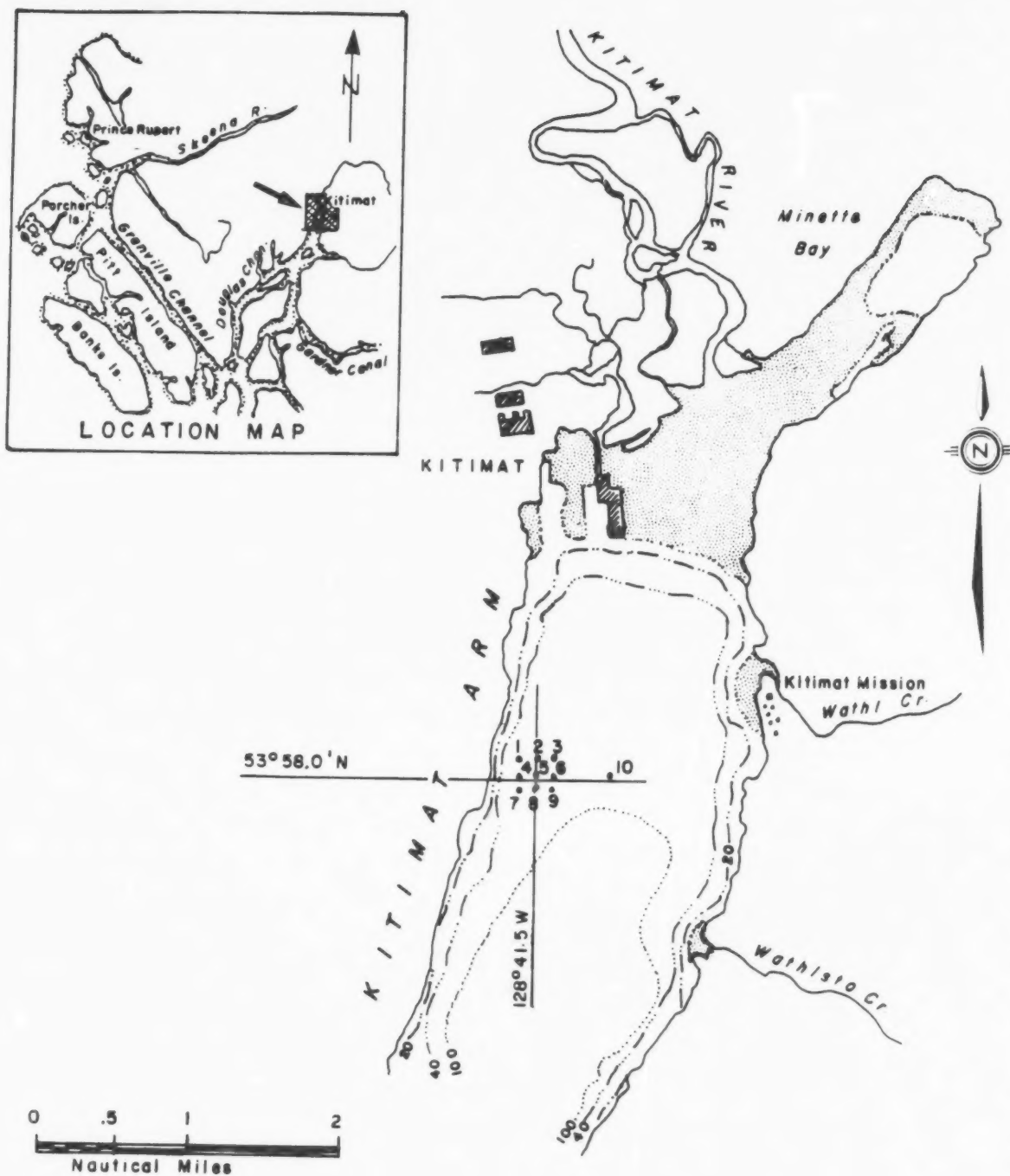


FIGURE 32 KITIMAT ARM OCEAN DUMPSITE - BENTHIC  
SEDIMENT SAMPLING STATIONS

**TABLE 41** KITIMAT ARM OCEAN DUMP SITE - TRACE METAL CONCENTRATIONS\*  
IN BENTHIC SEDIMENTS - GRAB AND CORE SAMPLES - APRIL 1982

| STATION  | Hg   | Cd  | Pb   | Cu   | Zn   |
|----------|------|-----|------|------|------|
| 1        | 0.31 | 0.7 | 9.0  | 49.7 | 72.6 |
| 2        | 0.24 | 0.4 | 8.0  | 50.0 | 70.5 |
| 3        | 0.24 | 0.5 | 9.0  | 52.5 | 72.6 |
| 4        | 0.23 | 0.5 | 9.0  | 51.5 | 74.7 |
| 5        |      |     |      |      |      |
| 0-5 cm   | 0.23 | 0.6 | 8.0  | 45.4 | 63.1 |
| 10-15 cm | 0.23 | 0.6 | 10.0 | 50.2 | 71.7 |
| 20-25 cm | 0.23 | 0.7 | 9.0  | 53.4 | 78.0 |
| 6        | 0.24 | 0.5 | 10.0 | 52.1 | 73.8 |
| 7        | 0.24 | 0.5 | 9.0  | 49.6 | 74.5 |
| 8        | 0.24 | 0.6 | 10.0 | 53.5 | 77.0 |
| 9        | 0.23 | 0.5 | 9.0  | 51.7 | 74.0 |
| 10       |      |     |      |      |      |
| 0-5 cm   | 0.24 | 0.7 | 8.0  | 40.6 | 60.3 |
| 10-15 cm | 0.23 | 0.5 | 9.0  | 49.6 | 68.8 |
| 20-25 cm | 0.24 | 0.6 | 8.0  | 51.3 | 68.2 |

\* All results expressed in ug/g dry weight

DUMPSITE: PRINCE RUPERT HARBOUR  
NUMBER: 98  
CO-ORDINATES: 54°22.10'N 130°15.70'W  
DEPTH: 53 metres  
TOTAL QUANTITY  
DUMPED: 4 881 cubic metres  
COMMENTS:

Historical records show dumping occurred in the harbour prior to the 1930's. This site was created in 1980 and the previous dumpsite number was maintained.

**LOADSITE INFORMATION:**

Material disposed of at the Prince Rupert Harbour dumpsite has originated from dredging operations in and around Prince Rupert. The site was established in 1980 to accommodate dredge spoils from a local ferry terminal, however, the project was cancelled. The site was first used in 1982 (O.D.C.A. file no. -01383) for disposal of 600 cubic metres of silt and rock from Seal Cove in Fern Passage. The Canadian Coast Guard base in Seal Cove was expecting a new vessel requiring a greater water depth. The same area was dredged in 1985 when 1,600 cubic metres of sand and rock were removed by Public Works Canada to improve navigation and berthing. The material dredged from Seal Cove was not expected to be contaminated although the only available chemical data for the area was very scant. The Fern Passage area is used extensively by juvenile salmon during the spring and summer and the quiescent embayments are important holding areas for returning adult salmon in late summer and early fall. The Department of Fisheries and Oceans would generally like dredging and dumping scheduled between October 1 and April 1 to protect fishery resources. The dumpsite is close to commercial and sport shellfish and salmon fisheries and should be restricted to small volumes of uncontaminated material.

In 1985, the Prince Rupert Fisherman's Co-operative dredged adjacent to their cannery wharf to provide greater depth for seine boats. Approximately 1 300 cubic metres of silt and mud were dumped at the site.

R.O.D.A.C. is currently reviewing an application from Wedeene River Contracting (O.D.C.A. file no. -02005) to dredge the foreshore adjacent to a proposed sawmill in Fern Passage. The original proposal to dredge and dump over 60 000 cubic metres of material was rejected owing to the excessive volume. The company has subsequently revised their plans and have asked approval to dump 2 500 cubic metres of material. R.O.D.A.C. have requested sampling and analysis of sediments proposed for dumping and will consider the revised proposal on receipt of the data.

#### **RESEARCH INFORMATION:**

A research project was initiated in 1979 (O.D.C.A.R.F. no. 5.2.2) to review the existing oceanographic and fishery information related to ocean dumping in the Prince Rupert area. Various sites were ranked for their suitability as dumpsites based on biological and oceanographic criteria (see discussion for dumpsite No. 100).

DUMPSITE: BROWN PASSAGE  
NUMBER: 100  
CO-ORDINATES: 54°18.70'N 130°45.0'W  
DEPTH: 180 metres  
TOTAL QUANTITY  
DUMPED: 61 110 cubic metres  
COMMENTS:

Previous dumping occurred at 54°18.50'N 130°45.5'W.

LOADSITE INFORMATION:

The Brown Passage dumpsite in Chatham Sound was established by the Federal Ministry of Transport in 1946 for the disposal of ammunition and scrap metal. In the 1950's it was apparently used for disposal of fish offal from processing plants in the area. Interest in the dumpsite was revived in the late 1970's when the Canadian Cellulose Company was considering converting their sulphite pulpmill at Port Edward to the kraft process. It was felt that this conversion would significantly enhance the water quality in Porpoise Harbour, which had been improving in recent years through other pollution abatement measures.

The north end of Porpoise Harbour had historically been used for disposal of dredge spoils rich in organics from the pulpmill. The Department of Fisheries and Oceans wanted this practice to cease, thereby improving conditions in the Harbour for herring spawn, the rearing of juvenile herring, a local sport crab fishery and the migration of salmon and herring through the system. Dredging is generally restricted during this migratory period in May and June. To complicate matters, a spill of polychlorinated biphenyls (PCB's) at the pulpmill in January 1977 resulted in the rejection of two Canadian Cellulose ocean dumping applications (O.D.C.A. file numbers -00207, -00802). The contaminated foreshore area was eventually capped to prevent the spread of PCB's.

The need for an alternate disposal site out in Chatham Sound was obvious, however, the proximity of the important Flora Banks fish habitat at

the mouth of the Skeena River necessitated careful thought in choosing an appropriate location. As a consequence, a research project was funded in 1979 (O.D.C.A.R.F. No. 5.2.2) to evaluate various potential dumpsites in the area. As a result of this study, the Brown Passage site became officially designated by R.O.D.A.C. in 1982.

The first use of the site under the O.D.C.A. was in the fall of 1982 for disposal of 55 000 cubic metres of clay and silt. The material was removed from the new Prince Rupert Grain terminal at the north end of Ridley Island to provide greater depth for loading ships. In 1985, another 6,000 cubic metres of silt and sand from the same location was dumped at the site.

**RESEARCH INFORMATION:**

As noted above, research project O.D.C.A.R.F. number 5.2.2 assessed potential ocean dumping sites in the Prince Rupert area.

5.2.4 Miscellaneous Dumping.

DUMPSITE: NORTH BENTINCK ARM  
NUMBER: 92  
CO-ORDINATES: 52°23.00'N 126°49.00'W  
DEPTH: 200 metres  
TOTAL QUANTITY  
DUMPED: 40 850 cubic metres  
COMMENTS:

Site previously identified as Bella Coola.

DUMPSITE: PORPOISE HARBOUR  
NUMBER: 97  
CO-ORDINATES: 54°14.50'N 130°18.50'W  
DEPTH: 1 metre  
TOTAL QUANTITY  
DUMPED: 7 524 cubic metre  
COMMENTS:

Sidecast dredging and backfiling for pipeline installation.

DUMPSITE: BURRARD INLET - ROCHE POINT  
NUMBER: 122  
CO-ORDINATES: 49°17.50'N 122°57.60'W  
DEPTH: 20 metres  
TOTAL QUANTITY  
DUMPED: 3 000 cubic metres  
COMMENTS:

Experiment designed to evaluate effectiveness of oil skimmers.



DUMPSITE: VANCOUVER HARBOUR - NHB FILL SITE  
NUMBER: 123  
CO-ORDINATES: 49°17.20'N 123°06.40'W  
DEPTH: not less than 1 metre  
TOTAL QUANTITY  
DUMPED: 100 000 cubic metres  
COMMENTS:

Foreshore development project.

DUMPSITE: DILLINGHAM SITE  
NUMBER: 124  
CO-ORDINATES: 49°18.00'N 123°02.40'W xb  
DEPTH: 15 metres  
TOTAL QUANTITY  
DUMPED: 19 600 cubic metres  
COMMENTS:

Mattress construction to form a sit-down pad for a large scow used to transport concrete caissons.

DUMPSITE: FALSE CREEK  
NUMBER: 125  
CO-ORDINATES: 49°16.50'N 123°06.30'W  
DEPTH: 5 metres  
TOTAL QUANTITY  
DUMPED: 58 800 cubic metres  
COMMENTS:

Various dumpsites created for the revitalization of the south shore of False Creek and the foreshore construction related to Expo'86 development.

DUMPSITE: ROBERTS BANK - STRAIT OF GEORGIA  
NUMBER: 126  
CO-ORDINATES: 49°00.70'N 123°10.50'W  
DEPTH: 40 metres  
TOTAL QUANTITY  
DUMPED: 285 000 cubic metres  
COMMENTS:

Construction of Roberts Bank Terminal

DUMPSITE: MCNEILL BAY - STRAIT OF JUAN DE FUCA  
NUMBER: 127  
CO-ORDINATES: 48°24.60'N 123°18.30'W  
DEPTH: 1 metre  
TOTAL QUANTITY  
DUMPED: 500 cubic metres  
COMMENTS:

Sewage outfall construction.

DUMPSITE: SWARTZ BAY  
NUMBER: 128  
CO-ORDINATES: 48°41.00'N 123°24.50'W  
DEPTH: not less than 1 metre  
TOTAL QUANTITY  
DUMPED: 1 790 cubic metres  
COMMENTS:

Maintenance dredging material used for stabilizing fill at ferry terminal site.

DUMPSITE: GANGES HARBOUR  
NUMBER: 129  
CO-ORDINATES: 48°50.10'N 123°26.40'W  
DEPTH: 1 metre  
TOTAL QUANTITY  
DUMPED: 20 000 cubic metres  
COMMENTS:

Backfill material for sewage outfall construction in Ganges Harbour.

DUMPSITE: LAMBERT CHANNEL - HORNBY ISLAND  
NUMBER: 131  
CO-ORDINATES: 49°30.10'N 124°41.20'W  
DEPTH: 30 metres  
TOTAL QUANTITY  
DUMPED: Nil  
COMMENTS:

Site chosen for sinking of M.V. Lady Grace for recreational scuba diving attraction.

DUMPSITE: CAPE LAZO  
NUMBER: 132  
CO-ORDINATES: 49°42.00'N 124°50.00'W  
DEPTH: 1 metre  
TOTAL QUANTITY  
DUMPED: 16 000 cubic metres  
COMMENTS:

Installation of sewage outfall involving trench construction and backfill material.

DUMPSITE: LITTLE RIVER - STRAIT OF GEORGIA  
NUMBER: 133  
CO-ORDINATES: 49°46.50'N 124°47.00'W  
DEPTH: 340 metres  
TOTAL QUANTITY  
DUMPED: 3 236 cubic metres  
COMMENTS:

Maintenance dredging at Little River ferry terminal.

DUMPSITE: BEAVER COVE  
NUMBER: 134  
CO-ORDINATES: 50°32.00'N 126°51.60'W  
DEPTH: 18 metres  
TOTAL QUANTITY  
DUMPED: NIL  
COMMENTS:

Maintenance dredging material in dryland port area relocated to location 50 metres seaward of dredge site.

DUMPSITE: MALASPINA HULKS  
NUMBER: 135  
CO-ORDINATES: 49°51.80'N 124°33.40'W  
DEPTH: 36 metres  
TOTAL QUANTITY  
DUMPED: 24 750 cubic metres  
COMMENTS:

Disposal of cadmium contaminated dredged material to edge of log pond at MacMillan Bloedel Powell River Division.

DUMPSITE: TEXADA ISLAND  
NUMBER: 136  
CO-ORDINATES: Cape Cockburn 49°40.40'N 124°12.20'W  
Texada (East) 49°38.00'N 124°12.20'W  
Texada (West) 49°35.40'N 124°21.30'W  
Nile Creek 49°25.40'N 124°38.50'W  
  
DEPTH: All of the above are not less than 1 metre  
  
TOTAL QUANTITY  
DUMPED: 38 000 cubic metres  
COMMENTS:

This project involved the construction of the B.C. Hydro Cheekye-Dunsmuir Transmission line from the mainland, across Texada Island to Vancouver Island and involved dredging and/or dumping operations at four sites; Cape Cockburn (Nelson Island), Texada Island (East), Texada Island (West) and Nile Creek (Vancouver Island).

For simplification, the project has been catalogued under Texada Island.

DUMPSITE: GIBSON'S HARBOUR  
NUMBER: 137  
CO-ORDINATES: 49°23.90'N 123°30.20'W  
DEPTH: 1 metre  
  
TOTAL QUANTITY  
DUMPED: 149 098 cubic metres  
COMMENTS:

Construction of marina breakwater.

DUMPSITE: PORTEAU COVE PROVINCIAL PARK  
NUMBER: 138  
CO-ORDINATES: 49°33.00'N 123°14.00'W  
DEPTH: 9 metres  
TOTAL QUANTITY  
DUMPED: 445 metric tonnes  
COMMENTS:

Sinking of vessels for recreational SCUBA diving attractions.

DUMPSITE: HOWE SOUND INCINERATION SITE  
NUMBER: 139  
CO-ORDINATES: 49°29.80'N 123°28.60'W  
DEPTH: 9 metres  
TOTAL QUANTITY  
DUMPED: 4 427 litres  
COMMENTS:

Experiments to test incineration of oil spilled at sea.

DUMPSITE: QUEEN CHARLOTTE STRAIT  
NUMBER: 140  
CO-ORDINATES: 50°46.40'N 127°22.60'W  
DEPTH: 390 metres  
TOTAL QUANTITY  
DUMPED: 9 642 cubic metres  
COMMENTS:

Dredge spoil from log dumping and booming grounds to provide greater depth.

DUMPSITE: BROWNING ENTRANCE  
NUMBER: 141  
CO-ORDINATES: Between 53°44.00'N 130°32.00'W and  
53°40.00'N 130°40.00'W  
DEPTH: 40 metres  
TOTAL QUANTITY  
DUMPED: 164 000 litres  
COMMENTS:

Disposal of sewage sludge from Kitkatla Indian Reserve.

DUMPSITE: HARTLEY BAY, DOUGLAS CHANNEL  
NUMBER: 142  
CO-ORDINATES: 53°25.20'N 129°14.40'W  
DEPTH: 250 metres  
TOTAL QUANTITY  
DUMPED: 127 279 cubic metres  
COMMENTS:

Construction of a small craft harbour at head of Hartley Bay.

DUMPSITE: YAKOUN RIVER  
NUMBER: 143  
CO-ORDINATES: 53°40.00'N 132°12.00'W  
DEPTH: not less than 1 metre  
TOTAL QUANTITY  
DUMPED: 3 400 kilograms  
COMMENTS:

Fertilizer applied to intertidal area of Yakoun River estuary to enhance the productivity of the intertidal zone and thereby increase availability of food for juvenile salmonids utilizing the Estuary.



DUMPSITE: OBSERVATORY INLET  
NUMBER: 110  
CO-ORDINATES: 55°53.3'N 130°00.60'W  
DEPTH: 146 metres  
TOTAL QUANTITY  
DUMPED: 8 655 cubic metres  
COMMENTS:

Maintenance dredging at barge ramp sites.

DUMPSITE: SHINGLE POINT, YUKON TERRITORY  
NUMBER: 144  
CO-ORDINATES: 69°03.00'N 137°15.00'W  
DEPTH: 3 metres  
TOTAL QUANTITY  
DUMPED: 48 litres  
COMMENTS:

Small scale oil dispersant test in the Beaufort Sea.

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APPENDIX I

DUMP SITE SUMMARIES

DUMPSITE: POINT GREY  
NO.: 1

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                           | QUANTITY<br>(cu m) |  | COMMENTS          |
|----------------|------|---------------------------|------------------------------------|--------------------|--|-------------------|
|                |      |                           |                                    |                    |  |                   |
| 00642          | 1979 | Byrne Pile Driving        | Mainland various                   | 6 652              |  |                   |
| 00666          | 1979 | Canadian Forest Products  | Fraser R. North Arm                | 4 346              |  |                   |
| 00664          | 1979 | MacMillan Bloedel         | Fraser R. North Arm                | 22 119             |  |                   |
| 00713          | 1979 | Dept. Public Works Canada | Fraser R. North Arm                | 3 450              |  |                   |
| 00673          | 1979 | Valley Towing Blanket     | Fraser R. Lower Mainland           | 1 909              |  |                   |
| 00686          | 1979 | Canadian Mortgage/Housing | Granville Isl. False Crk.          | 10 650             |  |                   |
| 00707          | 1979 | Crown Zellerbach          | Fraser R. North Arm                | 1 500              |  |                   |
| 00735          | 1979 | Fraser River Pile Driving | Fraser R. various sites            | 17 012             |  |                   |
| 00779          | 1979 | Arrow Trans Systems       | -                                  | 1 500              |  | Demolition debris |
| 00785          | 1979 | Rayonier                  | Fraser River<br>various mill sites | 13 100             |  |                   |
| 00808          | 1979 | Dillingham Blanket        | Vancouver Harb. var. sites         | 57 350             |  |                   |
| 00709          | 1979 | Fraser River Pile Driving | Fraser R. North Arm                | 18 300             |  |                   |
| 00809          | 1979 | Macleod Geotechnical Ltd. | Coal Harbour Vancouver             | 37 082             |  |                   |

DUMPSITE: POINT GREY  
NO.: 1

| FILE<br>NUMBER | YEAR | PROPONENT                  | LOADSITE                                    | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|----------------------------|---------------------------------------------|--------------------|----------|
| 00824          | 1979 | Winvan Paving Ltd.         | Vancouver                                   | 12 000             |          |
| 00762          | 1979 | Mainland Sawmills          | Fraser R. North Arm                         | 3 230              |          |
| 00763          | 1979 | Terminal Sawmills          | Fraser R. North Arm                         | 1 000              |          |
| 00766          | 1979 | Bay Forest Products        | False Creek                                 | 4 550              |          |
| 00844          | 1979 | Fraser River Pile Driving  | North Vancouver                             | 8 250              |          |
| 00850          | 1979 | North Fraser Harbour Comm. | Point Grey scow moor<br>Fraser R. North Arm | 9 700              |          |
| 00827          | 1979 | Dept. Public Works Canada  | Fraser R. Various sites                     | NIL                |          |
| 00849          | 1980 | Fraser River Pile Driving  | Fraser River Burnaby                        | 3 750              |          |
| 00845          | 1980 | Burrard Yarrows            | Burrard Inlet N. Van.                       | 30 000             |          |
| 00872          | 1980 | Byrne Pile Driving         | Fraser R. various sites                     | 12 500             |          |
| 00884          | 1980 | Canadian Forest Products   | Fraser R. North Arm                         | 9 828              |          |
| 00873          | 1980 | MacMillan Bloedel          | Fraser R. various sites                     | 20 680             |          |
| 00905          | 1980 | B.C. Forest Tech. Serv.    | Fraser R. North Arm                         | 3 825              |          |
| 00861          | 1980 | Crown Zellerbach           | Fraser River                                | 6 500              |          |

DUMPSITE: POINT GREY  
NO.: 1

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                                             | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|------------------------------------------------------|--------------------|----------|
| 00923          | 1980 | Valley Towing blanket     | Fraser R. Vancouver Harb.                            | 11 500             |          |
| 00894          | 1980 | Fraser River Pile Driving | Vanc. Harb. various sites<br>Fraser R. various sites | 3 771              |          |
| 00998          | 1980 | Rayonier                  | Fraser R. var. mill sites                            | 16 311             |          |
| 01001          | 1980 | Hooker Chemicals          | Hooker Chemical Division                             | 4 000              |          |
| 00956          | 1980 | Dillingham Blanket        | Fraser R. Estuary<br>Vancouver Harbour               | 40 000             |          |
| 01024          | 1980 | Aime Enterprises          | Vancouver Harbour                                    | 24 467             |          |
| 00921          | 1980 | Crown Zellerbach          | Fraser R. North Arm                                  | 4 478              |          |
| 00968          | 1980 | Bay Forest Products       | False Creek                                          | 4 129              |          |
| 01054          | 1981 | Southwest Contracting     | False Creek                                          | 54 166             |          |
| 01044          | 1981 | Mainland Sawmills         | Fraser River                                         | 3 058              |          |
| 01045          | 1981 | Terminal Sawmills         | Fraser River                                         | 3 058              |          |
| 01056          | 1981 | Dept. Public Works Canada | Fraser R. various sites                              | NIL                |          |
| 01064          | 1981 | Canadian Forest Products  | Fraser R. North Arm                                  | 3 900              |          |
| 01053          | 1981 | MacMillan Bloedel         | Fraser R. North Arm                                  | 22 525             |          |

DUMPSITE: POINT GREY  
NO.: 1

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                               | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|----------------------------------------|--------------------|----------|
| 01067          | 1981 | Crown Zellerbach          | Fraser R. North Arm                    | 3 200              |          |
| 01108          | 1981 | Dillingham                | False Creek                            | 75 000             |          |
| 01106          | 1981 | Valley Towing Blanket     | Fraser R. Estuary<br>Vancouver Harbour | 13 686             |          |
| 01115          | 1981 | Fraser River Pile Driving | Fraser River<br>Vancouver Harbour      | 60 660             |          |
| 01188          | 1981 | Weldwood                  | Flavelle Cedar Mill<br>Burrard Inlet   | 4 000              |          |
| 01210          | 1981 | Klondike Industries Ltd.  | False Creek                            | 11 000             |          |
| 01116          | 1981 | Intercon Management       | Seapoint Marina, False Crk.            | 1 400              |          |
| 01203          | 1981 | Fownes Contracting        | False Creek                            | 61 000             |          |
| 01065          | 1981 | Dillingham Blanket        | Fraser River<br>Vancouver Harbour      | 6 937              |          |
| 01245          | 1981 | Narod Construction Ltd.   | False Creek                            | 2 000              |          |
| 01238          | 1981 | Bay Forest Products       | False Creek                            | 1 269              |          |



DUMPSITE: POINT GREY  
NO.: 1

| FILE<br>NUMBER | YEAR | PROPONENT                    | LOADSITE                                              | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|------------------------------|-------------------------------------------------------|--------------------|----------|
| 01277          | 1982 | Royal Vancouver Yacht Club   | Coal Harbour Vancouver                                | 6 881              |          |
| 01268          | 1982 | MacMillan Bloedel            | Fraser R. various sites                               | 16 140             |          |
| 01280          | 1982 | Canadian Forest Products     | Fraser R. North Arm                                   | 11 900             |          |
| 01279          | 1982 | Crown Zellerbach             | Fraser R. North Arm                                   | 4 300              |          |
| 01242          | 1982 | Western Forest Products Ltd. | Silvertree Sawmill Div.<br>Fraser R.                  | 3 000              |          |
| 01287          | 1982 | Valley Towing Blanket        | Fraser R. Estuary<br>Vancouver Harbour                | 8 716              |          |
| 01286          | 1982 | Fraser River Pile Driving    | Fraser R. Estuary<br>Vancouver Harbour                | 32 800             |          |
| 01285          | 1982 | City of Vancouver Parks      | Burrard Civic Marina                                  | 3 000              |          |
| 01278          | 1982 | Dept. Public Works Canada    | Fraser R. Various Sites                               | 47 350             |          |
| 01296          | 1982 | Terminal Sawmills            | Fraser R. North Arm                                   | 9 000              |          |
| 01297          | 1982 | Mainland Sawmills            | Fraser R. North Arm                                   | 2 850              |          |
| 01323          | 1982 | Dillingham Blanket           | Fraser R. Various sites<br>Vancouver Harb. Var. sites | 1 500              |          |

DUMPSITE: POINT GREY  
NO.: 1

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                                               | QUANTITY<br>(cu m) | COMMENTS                             |
|----------------|------|---------------------------|--------------------------------------------------------|--------------------|--------------------------------------|
| 01391          | 1982 | Bay Forest Products       | False Creek                                            | 1 070              |                                      |
| 01360          | 1983 | C H Cates & Sons          | Vancouver Harbour                                      | 1 147              |                                      |
| 01299          | 1983 | City of Vancouver Parks   | False Creek                                            | 5 000              |                                      |
| 01412          | 1983 | Crown Zellerbach          | Fraser R. North Arm                                    | 3 900              |                                      |
| 01432          | 1983 | Canadian Forest Products  | Fraser R. North Arm                                    | 9 563              |                                      |
| 01410          | 1983 | Weldwood                  | Flavelle Cedar Mill                                    | 3 500              |                                      |
| 01414          | 1983 | Valley Towing Blanket     | Vancouver Harb. var. sites<br>Fraser River Estuary     | 16 745             |                                      |
| 01433          | 1983 | MacMillan Bloedel         | Fraser R. Various sites                                | 15 808             |                                      |
| 01435          | 1983 | Fraser River Pile Driving | Vancouver Har. var. sites<br>Fraser R. Est. var. sites | 9 400              |                                      |
| 01474          | 1983 | Expo '86                  | False Creek                                            | 16 900             |                                      |
| 01436          | 1983 | B.C. Place                | B.C. Place Development<br>in False Creek               | 100 000            | Stockpiled excavation<br>material    |
| 01471          | 1983 | B.C. Place                | B.C. Place Development<br>in False Creek               | 67 000             | Excavated material<br>from shoreline |
| 01404          | 1983 | B.C. Place                | False Creek                                            | 154 000            | Subsurface dredged<br>material       |

DUMPSITE: POINT GREY  
NO.: 1

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                                                   | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|------------------------------------------------------------|--------------------|----------|
| 01510          | 1983 | Dept. Public Works Canada | Fraser R. Various sites                                    | 215 000            |          |
| 01513          | 1983 | Dillingham Blanket        | Fraser River Estuary<br>Vancouver Harb. var. sites         | 2 800              |          |
| 01532          | 1983 | Mainland Sawmills         | Fraser R. North Arm                                        | 8 300              |          |
| 01505          | 1983 | B.C. Forest Products      | Fraser R. North Arm                                        | 229                |          |
| 01568          | 1984 | B.C. Place                | B.C. Place Development<br>in False Creek                   | 21 400             |          |
| 01572          | 1984 | Valley Towing Blanket     | Fraser River Estuary<br>Vancouver Harbour                  | 19 408             |          |
| 01634          | 1984 | Canadian Forest Products  | Fraser R. North Arm                                        | 6 300              |          |
| 01514          | 1984 | Terminal Sawmills         | Fraser R. North Arm                                        | 6 804              |          |
| 01635          | 1984 | Fraser River Pile Driving | Fraser River Estuary<br>Vancouver Harbour                  | 34 000             |          |
| 01637          | 1984 | MacMillan Bloedel         | Fraser R. Various sites                                    | 26 235             |          |
| 01638          | 1984 | Dillingham Blanket        | Vancouver Harb. var. sites<br>Fraser R. Estuary var. sites | 1 529              |          |

DUMPSITE: POINT GREY  
NO.: 1

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                                 | QUANTITY<br>(cu m) | COMMENTS                             |
|----------------|------|---------------------------|------------------------------------------|--------------------|--------------------------------------|
| 01674          | 1984 | B.C. Place                | B.C. Place Development<br>in False Creek | NIL                | Excavated material<br>from shoreline |
| 01698          | 1984 | B.C. Place                | B.C. Place Development<br>in False Creek | 22 900             | Stockpiled excavation<br>material    |
| 01699          | 1984 | B.C. Place                | False Creek, B.C.                        | 19 000             | Sub-surface dredged<br>material      |
| 01702          | 1984 | Rivtow                    | Manly Shipyard Fraser R.                 | 4 830              |                                      |
| 01705          | 1984 | Dept. Public Works Canada | Fraser R. various sites                  | NIL                |                                      |
| 01719          | 1984 | Ocean Fisheries Co.       | Rice Mill Fraser R. S. Arm               | 26 127             |                                      |
| 01741          | 1985 | Shell Canada              | Shellburn Refinery                       | 2 180              |                                      |
| 01743          | 1985 | Kingcome Navigation       | Vancouver Harbour                        | 3 300              |                                      |
| 01748          | 1985 | Johnston Terminals        | False Creek                              | 7 000              |                                      |
| 01756          | 1985 | Moray Channel Enterprises | Richmond Marina Fraser R.                | 13 982             |                                      |
| 01755          | 1985 | Dept. Public Works Canada | Fraser R. Various sites                  | NIL                |                                      |
| 01757          | 1985 | Vancouver Marina Ltd.     | Vancouver Marina Fraser R.               | 12 000             |                                      |
| 01751          | 1985 | Weidwood                  | Flavelle Cedar Mill<br>Burrard Inlet     | 6 000              |                                      |

DUMPSITE: POINT GREY  
NO.: 1

| FILE<br>NUMBER | YEAR | PROPONENT                   | LOADSITE                                                 | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|-----------------------------|----------------------------------------------------------|--------------------|----------|
| 01812          | 1985 | Valley Towing (blanket)     | Vancouver Harb. var. sites<br>Fraser River Estuary       | 17 942             |          |
| 01844          | 1985 | Canadian Forest Products    | Fraser R. North Arm                                      | 11 469             |          |
| 01815          | 1985 | Fraser River Pile Driving   | Vancouver Harb. var. sites<br>Fraser River Estuary       | 42 200             |          |
| 01850          | 1985 | MacMillan Bloedel           | Fraser River various sites                               | -                  |          |
| 01851          | 1985 | Pacific Coast Terminals     | Port Moody, B.C.                                         | 16 100             |          |
| 01863          | 1985 | Swan Wooster Engineering    | False Creek                                              | 5 100              |          |
| 01868          | 1985 | Mill & Timber Products      | Surrey, B.C.                                             | 16 800             |          |
| 01861          | 1985 | Anderson Marine Enterprises | Fraser River Various sites<br>Vancouver Harb. var. sites | 3 823              |          |
| 01866          | 1985 | Terminal Sawmills           | Richmond                                                 | -                  |          |
| 01867          | 1985 | Mainland Sawmills           | Mainland Sawmills                                        | -                  |          |
| 01884          | 1985 | Dillingham Blanket          | Vancouver Harb. var. sites                               | -                  |          |
| 01888          | 1985 | Dept. Public Works Canada   | False Creek                                              | -                  |          |
| 02002          | 1986 | Dept. Public Works Canada   | Fraser River Various sites                               | -                  |          |
| 02018          | 1986 | Belmont Construction        | West Vancouver Laboratory                                | -                  |          |

DUMPSITE: POINT GREY  
NO.: 1

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                                           | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|----------------------------------------------------|--------------------|----------|
| 01984          | 1986 | Valley Towing Blanket     | Vancouver Harb. var. sites<br>Fraser River Estuary | -                  |          |
| 02003          | 1986 | Vancouver Rowing Club     | Coal Harbour                                       | -                  |          |
| 02020          | 1986 | Westview Dredging         | Vancouver Harb. Var. Sites<br>Fraser River Estuary | -                  |          |
| 02022          | 1986 | Fraser River Pile Driving | Vancouver Harb. Var. Sites<br>Fraser River Estuary | -                  |          |
| 02024          | 1986 | MacMillan Bloedel         | Fraser River Various sites                         | -                  |          |

DUMPSITE: DEPT. PUBLIC WORKS CANADA NORTH ARM - SPOIL AREAS 8 AND 8A  
NO.: 8

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                   | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|----------------------------|--------------------|----------|
| 01056          | 1981 | Dept. Public Works Canada | Fraser River various sites | 115 000            |          |
| 01278          | 1982 | Dept. Public Works Canada | Fraser River various sites | 1 271 136          |          |
| 01510          | 1983 | Dept. Public Works Canada | Fraser River various sites | 134 000            |          |
| 01705          | 1984 | Dept. Public Works Canada | Fraser River various sites | 150 000            |          |
| 01755          | 1985 | Dept. Public Works Canada | Fraser River various sites | 311 163            |          |
| 02002          | 1986 | Dept. Public Works Canada | Fraser River various sites | -                  |          |

DUMPSITE: SAND HEADS  
NO.: 9

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                                                 | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|----------------------------------------------------------|--------------------|----------|
| 00642          | 1979 | Byrne Pile Driving        | Lower Mainland Sites var.                                | NIL                |          |
| 00673          | 1979 | Valley Towing Blanket     | Fraser River various sites                               | 8 940              |          |
| 00735          | 1979 | Fraser River Pile Driving | Fraser River various sites                               | 2 523              |          |
| 00808          | 1979 | Dillingham Blanket        | Vancouver Harb. var. sites<br>Fraser River various sites | 57 350             |          |
| 00827          | 1979 | Dept. Public Works Canada | Fraser River various sites                               | 324 865            |          |
| 00847          | 1979 | Granwest Industries       | Ladner                                                   | 3 600              |          |
| 00872          | 1980 | Byrne Pile Driving        | Fraser River various sites                               | NIL                |          |
| 00923          | 1980 | Valley Towing Blanket     | Fraser River various sites                               | 11 500             |          |
| 00894          | 1980 | Fraser River Pile Driving | Vancouver Harb. var. sites<br>Fraser River various sites | -                  |          |
| 00956          | 1980 | Dillingham Blanket        | Fraser River Estuary<br>Vancouver Harbour                | NIL                |          |
| 01106          | 1981 | Valley Towing Blanket     | Fraser River Estuary<br>Vancouver Harbour                | 916                |          |
| 01065          | 1981 | Dillingham Blanket        | Victoria Harbour<br>Fraser River<br>Vancouver Harbour    | NIL                |          |



DUMPSITE: SAND HEADS  
NO.: 9

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                                                | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|---------------------------------------------------------|--------------------|----------|
| 01115          | 1981 | Fraser River Pile Driving | Fraser River various sites<br>Vancouver Harbour         | 6 740              |          |
| 01223          | 1981 | Dept. Public Works Canada | Cannery Channel                                         | 10 000             |          |
| 01284          | 1982 | B.C. Telephone            | Annacis Channel Fraser R                                | 10 000             |          |
| 01287          | 1982 | Valley Towing Blanket     | Fraser River Estuary<br>Vancouver Harbour               | NIL                |          |
| 01286          | 1982 | Fraser River Pile Driving | Fraser River Estuary<br>Vancouver Harbour               | 6 200              |          |
| 01323          | 1982 | Dillingham Blanket        | Fraser River Estuary                                    | NIL                |          |
| 01357          | 1982 | B.C. Mfn. Transportation  | Fraser River South Arm                                  | 15 622             |          |
| 01414          | 1983 | Valley Towing Blanket     | Vancouver Harb. var. sites<br>Fraser River Estuary var. | NIL                |          |
| 01435          | 1983 | Fraser River Pile Driving | Fraser River Estuary<br>Vancouver Harb. var. sites      | 54 784             |          |
| 01513          | 1983 | Dillingham Blanket        | Fraser River Estuary                                    | NIL                |          |
| 01572          | 1984 | Valley Towing Blanket     | Fraser River Estuary                                    | 2 000              |          |
| 01635          | 1984 | Fraser River Pile Driving | Vancouver Harb. Var. sites<br>Fraser River Estuary      | 18 200             |          |
| 01638          | 1984 | Dillingham Blanket        | Fraser R. Estuary var. sites                            | NIL                |          |

DUMPSITE: SAND HEADS  
NO.: 9

| FILE<br>NUMBER | YEAR | PROPONENT                                       | LOADSITE                                                   | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|-------------------------------------------------|------------------------------------------------------------|--------------------|----------|
| 01719          | 1984 | Ocean Fisheries Co.                             | Rice Mill Fraser R., S. Arm                                | 26 127             |          |
| 01812          | 1985 | Valley Towing                                   | Fraser River various sites                                 | NIL                |          |
| 01815          | 1985 | Fraser River Pile Driving                       | Vancouver Harb. var. sites<br>Fraser R. estuary var. sites | 24 800             |          |
| 01861          | 1985 | Anderson Marine Ent.                            | Fraser River various sites<br>Vancouver Harb. var. sites   | NIL                |          |
| 01883          | 1985 | Dillingham<br>c/o B.C. Packers Ltd.             | B.C. Packers Richmond                                      | 10 288             |          |
| 01870          | 1985 | Fraser River Pile Driving<br>c/o B.C. Hydro Gas | Annacis Channel Fraser R.                                  | 14 300             |          |
| 01884          | 1985 | Dillingham Blanket                              | Vancouver Harb. Var. Sites<br>Victoria Harbour Var. Sites  | -<br>-             |          |
| 01886          | 1985 | Dept. Public Works Canada                       | Boat Basin at White Rock                                   | -                  |          |
| 01984          | 1986 | Valley Towing Blanket                           | Vancouver Harb. Var. Sites<br>Fraser R. Estuary var. sites | -                  |          |
| 02020          | 1986 | Westview Dredging                               | Vancouver Harb. Var. Sites<br>Fraser River Estuary         | -                  |          |
| 02022          | 1986 | Fraser River Pile Driving                       | Vancouver Harb. Var. Sites<br>Fraser River Estuary         | -                  |          |

**DUMPSITE: SAND HEADS - DEPT. PUBLIC WORKS CANADA SPOIL AREA NUMBER 1**  
**NO.: 9A**

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                   | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|----------------------------|--------------------|----------|
| 01056          | 1981 | Dept. Public Works Canada | Fraser River various sites | 953 000            |          |
| 01278          | 1982 | Dept. Public Works Canada | Fraser River various sites | 396 759            |          |
| 01510          | 1983 | Dept. Public Works Canada | Fraser River various sites | 1 318 000          |          |
| 01705          | 1984 | Dept. Public Works Canada | Fraser River various sites | 613 000            |          |
| 01755          | 1985 | Dept. Public Works Canada | Fraser River various sites | 864 992            |          |
| 02002          | 1986 | Dept. Public Works Canada | Fraser River various sites | -                  |          |

**DUMPSITE: VICTORIA**  
**NO.: 14**

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|----------|--------------------|----------|
| 00773          | 1979 | B.C. Hydro                | Victoria | 500                |          |
| 00796          | 1979 | Ocean Construction        | Victoria | 3 000              |          |
| 00815          | 1979 | B.C. Forest Products      | Victoria | 10 000             |          |
| 00820          | 1979 | Cleansteel Products       | Victoria | 5 000              |          |
| 00842          | 1979 | Oliver Equipment          | Victoria | 15 000             |          |
| 01003          | 1980 | Dept. Public Works Canada | Victoria | 18 000             |          |

DUMPSITE: VICTORIA  
NO.: 14

| FILE<br>NUMBER | YEAR | PROPONENT                   | LOADSITE                                        | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|-----------------------------|-------------------------------------------------|--------------------|----------|
| 01042          | 1980 | Oliver Equipment            | Victoria Harbour                                | 16 450             |          |
| 00956          | 1980 | Dillingham Blanket          | Victoria Harbour                                | NIL                |          |
| 01190          | 1981 | B.C. Forest Products        | Victoria Harbour                                | 5 375              |          |
| 01110          | 1981 | D.N.D.                      | Pedder Bay                                      | 1 447              |          |
| 01065          | 1981 | Dillingham Blanket          | Victoria Harbour                                | NIL                |          |
| 01247          | 1981 | Oliver Equipment            | Victoria Harbour                                | 9 000              |          |
| 01288          | 1982 | Robson Bulldozing           | Victoria Harbour                                | 8 000              |          |
| 01323          | 1982 | Dillingham Blanket          | Victoria Harbour var. sites                     | 1 000              |          |
| 01401          | 1983 | Dept. Public Works Canada   | Victoria Harbour                                | 3 000              |          |
| 01395          | 1983 | Const. Aggregates Ltd.      | Victoria Harbour                                | 1 000              |          |
| 01513          | 1983 | Dillingham Blanket          | Victoria Harbour var. sites                     | 2 829              |          |
| 01584          | 1984 | B.C. Forest Products        | Victoria Wood Products Div.<br>Victoria Harbour | 4 000              |          |
| 01638          | 1984 | Dillingham Blanket          | Victoria Harbour var. sites                     | NIL                |          |
| 01720          | 1985 | Island Research Development | Victoria Harbour                                | 4 500              |          |
| 01845          | 1985 | B.C. Forest Products        | Victoria Food Products Div.<br>Victoria Harbour | 6 000              |          |
| 01884          | 1985 | Dillingham Blanket          | Victoria Harbour var. sites                     | NIL                |          |

DUMPSITE: HARO STRAIT  
NO.: 18

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE         | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|------------------|--------------------|----------|
| 01385          | 1982 | North Saanich Marina      | Blue Heron Basin | 90 000             |          |
| 01537          | 1984 | Dept. Public Works Canada | Tsehum Harbour   | 16 548             |          |
| 01894          | 1986 | Dept. Public Works Canada | Patricia Bay     | -                  |          |

DUMPSITE: PORLIER PASS  
NO.: 32

| FILE<br>NUMBER | YEAR | PROPONENT            | LOADSITE                  | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|----------------------|---------------------------|--------------------|----------|
| 00814          | 1979 | B.C. Forest Products | Crofton Pulp & Paper Mill | 24 465             |          |
| 01107          | 1981 | B.C. Forest Products | Crofton Pulp & Paper Mill | 14 000             |          |
| 01298          | 1982 | B.C. Forest Products | Crofton Pulp & Paper Mill | 4 000              |          |
| 01848          | 1985 | B.C. Forest Products | Crofton Pulp & Paper Mill | 9 700              |          |
| 02019          | 1986 | Doman Forest Ltd.    | Ladysmith Harbour         | -                  |          |

DUMPSITE: FIVE FINGER  
NO.: 40

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                 | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|--------------------------|--------------------|----------|
| 01006          | 1980 | Dept. Public Works Canada | Nanaimo Harbour          | 5 500              |          |
| 01889          | 1986 | Dept. Public Works Canada | Newcastle Island Passage | -                  |          |
| 02020          | 1986 | Westview Dredging         | Nanaimo Harbour          | -                  |          |

DUMPSITE: FRENCH CREEK  
NO.: 44

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                  | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|---------------------------|--------------------|----------|
| 01503          | 1983 | Dept. Public Works Canada | French Creek boat harbour | 10 500             |          |

DUMPSITE: COMOX  
NO.: 48

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                    | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|-----------------------------|--------------------|----------|
| 01212          | 1981 | Dept. Public Works Canada | Comox Harbour public marina | 1 346              |          |

DUMPSITE: MALASPINA STRAIT  
NO.: 49

| FILE<br>NUMBER | YEAR | PROPONENT         | LOADSITE                                         | QUANTITY<br>(cu m) | COMMENTS                                                                             |
|----------------|------|-------------------|--------------------------------------------------|--------------------|--------------------------------------------------------------------------------------|
| 00765          | 1979 | MacMillan Bloedel | Powell River                                     | 12 000             | Dumped at 49°52.00'N,<br>123°36.00'W near<br>Harwood Island. Site is<br>now inactive |
| 00954          | 1980 | MacMillan Bloedel | Powell River Division                            | 29 053             |                                                                                      |
| 00953          | 1980 | MacMillan Bloedel | Powell River log pond<br>Teakerne Arm operations | 2 294              |                                                                                      |
| 01177          | 1981 | MacMillan Bloedel | Powell River Division                            | 17 500             |                                                                                      |
| 01173          | 1981 | MacMillan Bloedel | Powell River log pond<br>Teakerne Arm operations | 2 294              |                                                                                      |
| 01319          | 1982 | MacMillan Bloedel | Powell River Division                            | 13 800             |                                                                                      |
| 01470          | 1983 | MacMillan Bloedel | Powell River Division                            | 24 300             |                                                                                      |
| 01588          | 1984 | MacMillan Bloedel | Powell River Division                            | 24 000             |                                                                                      |
| 01811          | 1985 | MacMillan Bloedel | Powell River Division                            | 22 000             |                                                                                      |
| 02021          | 1986 | MacMillan Bloedel | Powell River Division                            | -                  |                                                                                      |



DUMPSITE: THORNBROUGH CHANNEL  
NO.: 64

| FILE<br>NUMBER | YEAR | PROPONENT                  | LOADSITE             | QUANTITY<br>(cu m) | COMMENTS                                         |
|----------------|------|----------------------------|----------------------|--------------------|--------------------------------------------------|
| 00807          | 1979 | Canadian Forest Products   | Port Mellon          | 3 830              |                                                  |
| 01041          | 1981 | Dept. Public Works Canada  | Gibsons Harbour      | 7 500              |                                                  |
| 01209          | 1981 | Canadian Forest Products   | Thornbrough Channel  | 13 650             | Material dumped at<br>at 49°31.20'N, 123°28.80'W |
| 01897          | 1986 | B.C. Ministry of Transport | Lions Bay Howe Sound | -                  |                                                  |

DUMPSITE: WATTS POINT  
NO.: 65

| FILE<br>NUMBER | YEAR | PROPONENT                    | LOADSITE         | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|------------------------------|------------------|--------------------|----------|
| 00460          | 1978 | Weldwood Empire Lumber       | Howe Sound       | 26 760             |          |
| 00588          | 1978 | Rayonier                     | Mill Creek Delta | 11 469             |          |
| 00631          | 1979 | MacMillan Bloedel            | Stawamus River   | 15 000             |          |
| 00708          | 1979 | L K Lumber                   | Squamish         | 1 350              |          |
| 00819          | 1979 | Rayonier                     | Mill Creek Delta | 8 258              |          |
| 00816          | 1980 | MacMillan Bloedel            | Stawamus River   | 12 845             |          |
| 00830          | 1980 | Weldwood Empire Lumber       | Squamish         | 23 700             |          |
| 01008          | 1980 | Western Forest Products Ltd. | Woodfibre        | 8 410              |          |

DUMPSITE: WATTS POINT  
NO.: 65

| FILE<br>NUMBER | YEAR | PROPONENT                    | LOADSITE         | QUANTITY<br>(cu m) | COMMENTS   |
|----------------|------|------------------------------|------------------|--------------------|------------|
| 01039          | 1981 | MacMillan Bloedel            | Squamish estuary | 11 010             |            |
| 01052          | 1981 | Weldwood Empire Lumber       | Mamquam Channel  | 14 000             | Squamish   |
| 01050          | 1981 | Weldwood Empire Logging      | Mamquam Channel  | 10 000             |            |
| 01204          | 1981 | Dept. Public Works Canada    | Mamquam Channel  | 40 500             |            |
| 01251          | 1982 | MacMillan Bloedel            | Squamish Estuary | 9 400              |            |
| 01234          | 1982 | Western Forest Products Ltd. | Woodfibre        | 11 000             |            |
| 01270          | 1982 | Weldwood Empire Logging      | Mamquam Channel  | 8 000              |            |
| 01281          | 1982 | Weldwood Empire Logging      | Mamquam Channel  | 12 000             |            |
| 01411          | 1983 | Western Pulp Limited         | Woodfibre        | 18 900             |            |
| 01413          | 1983 | Weldwood Empire Lumber       | Mamquam Channel  | 9 000              |            |
| 01561          | 1984 | Weldwood Empire Logging      | Mamquam Channel  | 5 540              |            |
| 01636          | 1984 | Western Pulp Limited         | Woodfibre        | 14 300             |            |
| 01747          | 1985 | Weldwood Empire Logging      | Mamquam Channel  | 765                | Howe Sound |
| 01847          | 1985 | Western Pulp Limited         | Woodfibre        | 8 258              |            |
| 01721          | 1985 | CRB Logging                  | Squamish Estuary | -                  |            |
| 01893          | 1986 | Weldwood Empire Logging      | Mamquam Channel  | -                  |            |
| 02017          | 1986 | Dept. Public Works Canada    | Mamquam Channel  | 17 018             |            |

DUMPSITE: KINGCOME INLET  
NO.: 75

| FILE<br>NUMBER | YEAR | PROPONENT | LOADSITE       | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|-----------|----------------|--------------------|----------|
| 01562          | 1984 | Whonnock  | Kingcome Inlet | 23 059             |          |

DUMPSITE: PORT ALICE  
NO.: 79

| FILE<br>NUMBER | YEAR | PROPONENT               | LOADSITE             | QUANTITY<br>(cu m) | COMMENTS                            |
|----------------|------|-------------------------|----------------------|--------------------|-------------------------------------|
| 01233          | 1981 | Crofttech Port Alice    | Port Alice Pulp Mill | 4 500              | Dumpsite 50°23.10'N,<br>127°27.40'W |
| 01534          | 1983 | Western Forest Products | Port Alice Pulp Mill | 6 500              |                                     |
| 01704          | 1984 | Western Forest Products | Port Alice Pulp Mill | 9 500              |                                     |
| 01885          | 1985 | Western Forest Products | Port Alice Pulp Mill | 6 900              |                                     |

DUMPSITE: TANHSIS INLET  
NO.: 83

| FILE<br>NUMBER | YEAR | PROPONENT             | LOADSITE                                                     | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|-----------------------|--------------------------------------------------------------|--------------------|----------|
| 00832          | 1979 | Tahsis Co.            | Tahsis Sawmill                                               | 30 450             |          |
| 00843          | 1980 | Tahsis Co.            | Var. sites in Muchalat, Tlupana,<br>Tahsis & Zeballos Inlets | 10 130             |          |
| 01049          | 1981 | Tahsis Co.            | Var. sites in Muchalat, Tlupana,<br>Tahsis & Zeballos Inlets | 35 970             |          |
| 01253          | 1982 | Tahsis Co.            | Var. sites in Muchalat, Tlupana,<br>Tahsis & Zeballos Inlets | 8 980              |          |
| 01405          | 1983 | Tahsis Co.            | Var. sites in Muchalat, Tlupana,<br>Tahsis & Zeballos Inlets | 13 200             |          |
| 01587          | 1984 | CIP Forest Prod. Inc. | Var. sites in Muchalat, Tlupana,<br>Tahsis & Zeballos Inlets | 11 135             |          |
| 01858          | 1985 | CIP Forest Prod. Inc. | Var. sites in Muchalat, Tlupana,<br>Tahsis & Zeballos Inlets | 10 115             |          |
| 02025          | 1986 | CIP Forest Prod. Inc. | Var. sites in Muchalat, Tlupana,<br>Tahsis & Zeballos Inlets | -                  |          |

DUMPSITE: NEWCOMBE CHANNEL  
NO.: 86

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE         | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|------------------|--------------------|----------|
| 01027          | 1982 | Dept. Public Works Canada | Ucluelet Harbour | 61 110             |          |

DUMPSITE: PORT ALBERNI  
NO.: 88

- 220 -

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                                                                       | QUANTITY<br>(cu m) | COMMENTS                     |
|----------------|------|---------------------------|--------------------------------------------------------------------------------|--------------------|------------------------------|
| 00607          | 1978 | MacMillan Bloedel         | Port Alberni                                                                   | 122 320            |                              |
| 00826          | 1979 | MacMillan Bloedel         | Port Alberni                                                                   | 80 283             |                              |
| 00821          | 1979 | Dept. Public Works Canada | Fishermans Harbour Pt. Alberni                                                 | 6 000              |                              |
| 01033          | 1980 | MacMillan Bloedel         | Alberni Pacific<br>Alberni Pulp & Paper<br>Somass<br>Sproat Lake               | 62 999             |                              |
| 01227          | 1981 | MacMillan Bloedel         | Alberni Pacific<br>Alberni Pulp & Paper<br>Somass<br>Sproat Lake               | 69 349             |                              |
| 01224          | 1981 | Haggard Development Corp. | Alberni Inlet various sites                                                    | 8 411              | Special dumping<br>permitted |
| 01230          | 1981 | Dept. Public Works Canada | Clutesi Haven                                                                  | 6 000              |                              |
| 01384          | 1982 | MacMillan Bloedel         | Canal Sort<br>Alberni Pacific<br>Somass<br>Alberni Pulp & Paper<br>Sproat Lake | 38 651             |                              |
| 01533          | 1983 | MacMillan Bloedel         | Alberni Pacific<br>Alberni Pulp & Paper<br>Somass<br>Sproat Lake               | 36 800             |                              |

**DUMPSITE: PORT ALBERNI**  
**NO.: 88**

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                                                                       | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|--------------------------------------------------------------------------------|--------------------|----------|
| 01560          | 1984 | Can-Dive Services         | Somass River                                                                   | 3 000              |          |
| 01701          | 1984 | MacMillan Bloedel         | Alberni Pacific<br>Alberni Pulp & Paper<br>Somass<br>Sproat Lake<br>Canal Sort | 25 231             |          |
| 01865          | 1985 | MacMillan Bloedel         | Alberni Pulp & Paper<br>Somass<br>Sproat Lake                                  | 18 931             |          |
| 01892          | 1986 | Dept. Public Works Canada | China Creek Alberni Inlet                                                      | -                  |          |

**DUMPSITE: NORTH BENTINCK ARM**  
**NO.: 92**

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE    | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|-------------|--------------------|----------|
| 01381          | 1982 | Dept. Public Works Canada | Bella Coola | 40 850             |          |

DUMPSITE: KITIMAT ARM  
NO.: 93

| FILE<br>NUMBER | YEAR | PROPONENT      | LOADSITE             | QUANTITY<br>(cu m) | COMMENTS                            |
|----------------|------|----------------|----------------------|--------------------|-------------------------------------|
| 01269          | 1982 | Alcan Smelters | Alcan Terminal No. 1 | 9 175              | Dumpsite 53°59.30'N,<br>128°41.20'W |
| 01981          | 1986 | Alcan Smelters | Alcan Terminal No. 1 | 4 800              |                                     |

DUMPSITE: PORPOISE HARBOUR  
NO.: 97

| FILE<br>NUMBER | YEAR | PROPONENT            | LOADSITE         | QUANTITY<br>(cu m) | COMMENTS              |
|----------------|------|----------------------|------------------|--------------------|-----------------------|
| 01392          | 1982 | Pacific Northern Gas | Porpoise Harbour | 260                | Pipeline installation |

DUMPSITE: PRINCE RUPERT HARBOUR  
NO.: 98

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE     | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|--------------|--------------------|----------|
| 01383          | 1982 | Canadian Coast Guard      | Seal Cove    | 600                |          |
| 01706          | 1985 | Dept. Public Works Canada | Seal Cove    | 1 565              |          |
| 01859          | 1985 | Prince Rupert Fisherman's | Fairview Bay | 2 716              |          |



DUMPSITE: BROWN PASSAGE  
NO.: 100

| FILE<br>NUMBER | YEAR | PROPONENT           | LOADSITE      | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------|---------------|--------------------|----------|
| 01252          | 1982 | Prince Rupert Grain | Ridley Island | 55 391             |          |
| 01707          | 1984 | Prince Rupert Grain | Ridley Island | 5 719              |          |

DUMPSITE: NORTH PACIFIC OCEAN  
NO.: 107

| FILE<br>NUMBER | YEAR | PROPONENT          | LOADSITE           | QUANTITY<br>(cu m) | COMMENTS         |
|----------------|------|--------------------|--------------------|--------------------|------------------|
| 01530          | 1984 | B.C. Place         | False Creek        | 125 000            |                  |
| 01864          | 1986 | Port Kells Thermal | Port Kells Langley | -                  | Gypsum wallboard |

DUMPSITE: OBSERVATORY INLET  
NO.: 110

| FILE<br>NUMBER | YEAR | PROPONENT          | LOADSITE      | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|--------------------|---------------|--------------------|----------|
| 01842          | 1985 | Brinco Mining Ltd. | Stewart, B.C. | 1 010              |          |

DUMPSITE: VANCOUVER HARBOUR - INCINERATOR  
NO.: 112

| FILE<br>NUMBER | YEAR | PROPONENT        | LOADSITE          | QUANTITY<br>(MT) | COMMENTS            |
|----------------|------|------------------|-------------------|------------------|---------------------|
| 01117          | 1981 | Aqua Clean Ships | Vancouver Harbour | 1 000            | Incineration at sea |
| 01322          | 1982 | Aqua Clean Ships | Vancouver Harbour | 1 000            | Incineration at sea |
| 01511          | 1983 | Aqua Clean Ships | Vancouver Harbour | 1 000            | Incineration at sea |
| 01672          | 1984 | Aqua Clean Ships | Vancouver Harbour | 2 000            | Incineration at sea |
| 01862          | 1985 | Aqua Clean Ships | Vancouver Harbour | 900              | Incineration at sea |
| 02043          | 1986 | Aqua Clean Ships | Vancouver Harbour | -                | Incineration at sea |

DUMPSITE: GABRIOLA  
NO.: 113

| FILE<br>NUMBER | YEAR | PROPONENT    | LOADSITE     | QUANTITY<br>(MT) | COMMENTS                    |
|----------------|------|--------------|--------------|------------------|-----------------------------|
| 01982          | 1986 | B.R. Bezaire | Fraser River | 70 tonnes        | Sinking of derelict vessels |

DUMPSITE: THORMANBY ISLAND  
NO.: 114

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                  | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|---------------------------|--------------------|----------|
| 01034          | 1980 | Fraser River Pile Driving | Westpoint Lasqueti Island | 4 000              |          |
| 01037          | 1980 | Cove/Dixon & Co. Ltd.     | Secret Cove               | 1 000              |          |
| 01189          | 1981 | A M Stevens               | Halfmoon Bay              | 400                |          |

DUMPSITE: CAPE MUDGE  
NO.: 116

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                    | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|-----------------------------|--------------------|----------|
| 00885          | 1980 | Whonnock Menzies Bay      | Menzies Bay Campbell River  | 1 000              |          |
| 01239          | 1981 | B.C. Forest Products      | Elk River Timber Co.        | 30 584             |          |
| 01382          | 1983 | Dept. Public Works Canada | Campbell River Public Harb. | 36 000             |          |
| 01749          | 1985 | Sportfish Centre          | Discovery Marina            | 2 600              |          |

DUMPSITE: MUCHALAT INLET  
NO.: 117

| FILE<br>NUMBER | YEAR | PROPONENT             | LOADSITE                                                          | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|-----------------------|-------------------------------------------------------------------|--------------------|----------|
| 00843          | 1980 | Tahsis Co.            | Various sites in Muchalat, Tahsis,<br>Tlupana, and Zeballos Inlet | 35 880             |          |
| 01049          | 1981 | Tahsis Co.            | Various sites in Muchalat, Tahsis,<br>Tlupana, and Zeballos Inlet | 3 660              |          |
| 01253          | 1982 | Tahsis Co.            | Various sites in Muchalat, Tahsis,<br>Tlupana, and Zeballos Inlet | 15 580             |          |
| 01405          | 1983 | Tahsis Co.            | Various sites in Muchalat, Tahsis,<br>Tlupana, and Zeballos Inlet | 13 935             |          |
| 01587          | 1984 | CIP Forest Prod. Inc. | Various sites in Muchalat, Tahsis,<br>Tlupana, and Zeballos Inlet | 25,665             |          |
| 01858          | 1985 | CIP Forest Prod. Inc. | Various sites in Muchalat, Tahsis,<br>Tlupana, and Zeballos Inlet | 14 245             |          |
| 02025          | 1986 | CIP Forest Prod. Inc. | Various sites in Muchalat, Tahsis<br>Tlupana, and Zeballos Inlet  | -                  |          |

DUMPSITE: ELIZA PASSAGE  
NO.: 118

| FILE<br>NUMBER | YEAR | PROPONENT                | LOADSITE                                                            | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|--------------------------|---------------------------------------------------------------------|--------------------|----------|
| 00843          | 1980 | Tahsis Co.               | Various sites in Tahsis,<br>Zeballos, Muchalat & Tlupana<br>Inlets  | NIL                |          |
| 01049          | 1981 | Tahsis Co.               | Various sites in Tahsis,<br>Zeballos, Muchalat & Tlupana<br>Inlets  | 2 370              |          |
| 01253          | 1982 | Tahsis Co.               | Various sites in Tahsis,<br>Zeballos, Muchalat & Tlupana<br>Inlets  | 2 070              |          |
| 01405          | 1983 | Tahsis Co.               | Various sites in Tahsis,<br>Zeballos, Muchalat, & Tlupana<br>Inlets | NIL                |          |
| 01587          | 1984 | CIP Forest Products Inc. | Various sites in Tahsis,<br>Zeballos, Muchalat, & Tlupana<br>Inlets | 750                |          |
| 01858          | 1985 | CIP Forest Products Inc. | Various sites in Tahsis,<br>Zeballos, Muchalat, & Tlupana<br>Inlets | 240                |          |
| 02025          | 1986 | CIP Forest Products Inc. | Various sites in Tahsis,<br>Zeballos, Muchalat, & Tlupana<br>Inlets | -                  |          |

DUMPSITE: JOHNSTONE STRAIT - HICKEY POINT  
NO.: 119

| FILE<br>NUMBER | YEAR | PROPONENT         | LOADSITE                      | QUANTITY<br>(cu m) | COMMENTS        |
|----------------|------|-------------------|-------------------------------|--------------------|-----------------|
| 00896          | 1980 | MacMillan Bloedel | Kelsey Bay                    | 55 789             |                 |
| 01394          | 1983 | MacMillan Bloedel | Eve River<br>Kelsey Bay       | -<br>21 317        |                 |
| 01402          | 1983 | MacMillan Bloedel | Kelsey Bay Woodlands Division | 40 tonnes          | Breakwater Hulk |
| 01535          | 1983 | MacMillan Bloedel | Eve River                     | 11 768             |                 |
| 01536          | 1983 | MacMillan Bloedel | Kelsey Bay                    | 16 505             |                 |
| 01722          | 1984 | MacMillan Bloedel | Eve River                     | 4 635              |                 |
| 01723          | 1984 | MacMillan Bloedel | Kelsey Bay                    | 1 020              |                 |
| 02004          | 1986 | MacMillan Bloedel | Eve River                     | -                  |                 |

DUMPSITE: JOHNSTONE STRAIT - HANSON ISLAND  
NO.: 120

| FILE<br>NUMBER | YEAR | PROPONENT                    | LOADSITE     | QUANTITY<br>(cu m) | COMMENTS                            |
|----------------|------|------------------------------|--------------|--------------------|-------------------------------------|
| 01005          | 1981 | Crown Zellerbach Canada Ltd. | Beaver Cove  | 306                | dumped at<br>50°32.40'N 126°50.70'W |
| 01434          | 1983 | Dept. Public Works Canada    | Port McNeill | 19 000             |                                     |
| 01502          | 1983 | Dept. Public Works Canada    | Sointula     | 80 000             |                                     |

DUMPSITE: JOHNSTONE STRAIT - HANSON ISLAND (continued)  
NO.: 120

| FILE<br>NUMBER | YEAR | PROPONENT                    | LOADSITE     | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|------------------------------|--------------|--------------------|----------|
| 01539          | 1983 | MacMillan Bloedel            | Port McNeill | 20 000             |          |
| 01703          | 1984 | Western Forest Products Ltd. | Port McNeill | 750                |          |

DUMPSITE: MALCOLM ISLAND  
NO.: 121

| FILE<br>NUMBER | YEAR | PROPONENT                    | LOADSITE     | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|------------------------------|--------------|--------------------|----------|
| 01539          | 1984 | MacMillan Bloedel            | Port McNeill | 30 000             |          |
| 01703          | 1984 | Western Forest Products Ltd. | Port McNeill | 46 000             |          |
| 01740          | 1985 | Dept. Public Works Canada    | Port McNeill | 19 180             |          |
| 01814          | 1985 | Crown Forest Industries      | Beaver Cove  | -                  |          |

DUMPSITE: BURRARD INLET - ROCHE POINT  
NO.: 122

| FILE<br>NUMBER | YEAR | PROPONENT               | LOADSITE                        | QUANTITY<br>(litres) | COMMENTS                      |
|----------------|------|-------------------------|---------------------------------|----------------------|-------------------------------|
| 01023          | 1980 | Environmental Emergency | Shell Oil dock<br>Burrard Inlet | 3 000                | Crude oil clean-up<br>testing |



DUMPSITE: VANCOUVER HARBOUR - NATIONAL HARBOURS BOARD FILL SITE  
NO.: 123

| FILE<br>NUMBER | YEAR | PROPONENT       | LOADSITE                   | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|-----------------|----------------------------|--------------------|----------|
| 00845          | 1980 | Burrard Yarrows | Burrard Inlet N. Vancouver | 100 000            |          |

DUMPSITE: DILLINGHAM SITE  
NO.: 124

| FILE<br>NUMBER | YEAR | PROPONENT           | LOADSITE            | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------|---------------------|--------------------|----------|
| 00956          | 1980 | Dillingham Blanket  | Vancouver           | 15 000             |          |
| 01048          | 1981 | Vancouver Shipyards | Vancouver Shipyards | 4 600              |          |

DUMPSITE: FALSE CREEK  
NO.: 125

| FILE<br>NUMBER | YEAR | PROPONENT               | LOADSITE                  | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|-------------------------|---------------------------|--------------------|----------|
| 01299          | 1983 | City of Vancouver Parks | False Creek               | 15 000             |          |
| 01504          | 1983 | Expo '86                | False Creek               | 21 300             |          |
| 01512          | 1983 | B.C. Place              | False Creek               | 17 500             |          |
| 01675          | 1984 | B.C. Place              | False Creek various sites | 5 000              |          |

DUMPSITE: ROBERTS BANK  
NO.: 126

| FILE<br>NUMBER | YEAR | PROPONENT               | LOADSITE     | QUANTITY<br>(cu m) | COMMENTS              |
|----------------|------|-------------------------|--------------|--------------------|-----------------------|
| 01046          | 1982 | National Harbours Board | Roberts Bank | 285 000            | Terminal construction |

DUMPSITE: MCNEILL BAY - STRAIT OF JUAN DE FUCA  
NO.: 127

| FILE<br>NUMBER | YEAR | PROPONENT    | LOADSITE    | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|--------------|-------------|--------------------|----------|
| 01206          | 1981 | CRD Victoria | McNeill Bay | 500                |          |

DUMPSITE: SWARTZ BAY  
NO.: 128

| FILE<br>NUMBER | YEAR | PROPONENT     | LOADSITE   | QUANTITY<br>(cu m) | COMMENTS       |
|----------------|------|---------------|------------|--------------------|----------------|
| 00924          | 1980 | B.C. Highways | Swartz Bay | 1 790              | Ferry terminal |

DUMPSITE: GANGES HARBOUR  
NO.: 129

| FILE<br>NUMBER | YEAR | PROPONENT  | LOADSITE       | QUANTITY<br>(cu m) | COMMENTS       |
|----------------|------|------------|----------------|--------------------|----------------|
| 01192          | 1981 | CRD Ganges | Ganges Harbour | 20 000             | Sewage Outfall |

DUMPSITE: LAMBERT CHANNEL - HORNBY ISLAND  
NO.: 131

| FILE<br>NUMBER | YEAR | PROPONENT        | LOADSITE      | QUANTITY<br>(tonnes) | COMMENTS                              |
|----------------|------|------------------|---------------|----------------------|---------------------------------------|
| 01846          | 1985 | Robert Zielinski | Burrard Inlet | 4 000                | Vessel to be sunk<br>-M.V. Lady Grace |

DUMPSITE: CAPE LAZO  
NO.: 132

| FILE<br>NUMBER | YEAR | PROPONENT     | LOADSITE  | QUANTITY<br>(cu m) | COMMENTS                       |
|----------------|------|---------------|-----------|--------------------|--------------------------------|
| 01300          | 1982 | AES Cape Lazo | Cape Lazo | 16 000             | Sewage outfall<br>construction |

DUMPSITE: LITTLE RIVER  
NO.: 133

| FILE<br>NUMBER | YEAR | PROponent                | LOADSITE                             | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|--------------------------|--------------------------------------|--------------------|----------|
| 01018          | 1980 | B.C. Min. Transportation | Little River Ferry<br>Terminal Comox | 3 236              |          |

DUMPSITE: BEAVER COVE  
NO.: 134

| FILE<br>NUMBER | YEAR | PROponent                | LOADSITE                 | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|--------------------------|--------------------------|--------------------|----------|
| 01891          | 1986 | Canadian Forest Products | Beaver Cove Dryland Sort | 5 750              |          |

DUMPSITE: MALASPINA HULKS  
NO.: 135

| FILE<br>NUMBER | YEAR | PROponent         | LOADSITE              | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|-------------------|-----------------------|--------------------|----------|
| 01177          | 1981 | MacMillan Bloedel | Powell River Division | 17 150             |          |
| 01319          | 1982 | MacMillan Bloedel | Powell River Division | 7 600              |          |

DUMPSITE: TEXADA ISLAND  
NO.: 136

| FILE<br>NUMBER | YEAR | PROPONENT  | LOADSITE                                                                | QUANTITY<br>(cu m)                 | COMMENTS                                           |
|----------------|------|------------|-------------------------------------------------------------------------|------------------------------------|----------------------------------------------------|
| 01066          | 1981 | B.C. Hydro | Cape Cockburn<br>Texada Island East<br>Texada Island West<br>Nile Creek | 2 000<br>12 000<br>4 000<br>30 000 | B.C. Hydro Cheekye -<br>Dunsmuir Transmission Line |

DUMPSITE: GIBSON'S HARBOUR  
NO.: 137

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE          | QUANTITY<br>(cu m) | COMMENTS                             |
|----------------|------|---------------------------|-------------------|--------------------|--------------------------------------|
| 01063          | 1983 | Dept. Public Works Canada | Gibsons's Harbour | 149,098            | Construction of marina<br>breakwater |

DUMPSITE: PORTEAU COVE PROVINCIAL PARK  
NO.: 138

| FILE<br>NUMBER | YEAR | PROPONENT             | LOADSITE     | QUANTITY<br>(m T) | COMMENTS            |
|----------------|------|-----------------------|--------------|-------------------|---------------------|
| 00906          | 1980 | B.C. Lands Parks      | Fraser River | 137<br>63.5       | Vessels<br>concrete |
| 01871          | 1985 | B.C. Ministry of Land | Squamish     | 260               | Vessel              |

DUMPSITE: HOME SOUND INCINERATION SITE  
NO.: 139

| FILE<br>NUMBER | YEAR | PROPONENT           | LOADSITE    | QUANTITY<br>(litres) | COMMENTS                       |
|----------------|------|---------------------|-------------|----------------------|--------------------------------|
| 01009          | 1980 | Dome Petroleum Ltd. | Port Mellon | 1 635                | Crude oil incineration testing |
| 01860          | 1985 | Ocean Ecology       | Howe Sound  | 2 792                | Crude oil incineration testing |

DUMPSITE: QUEEN CHARLOTTE STRAIT  
NO.: 140

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE             | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|----------------------|--------------------|----------|
| 01570          | 1984 | B.C. Ministry of Forestry | Hardy Bay Port Hardy | 6 413              |          |

DUMPSITE: BROWNING ENTRANCE  
NO.: 141

| FILE<br>NUMBER | YEAR | PROPONENT           | LOADSITE                                  | QUANTITY<br>(litres) | COMMENTS        |
|----------------|------|---------------------|-------------------------------------------|----------------------|-----------------|
| 01569          | 1984 | Fast Septic Service | Kitkatla Indian Reserve<br>Dolphin Island | 164 000              | Sewage disposal |

DUMPSITE: HARTLEY BAY, DOUGLAS CHANNEL  
NO.: 142

| FILE<br>NUMBER | YEAR | PROPONENT                 | LOADSITE                       | QUANTITY<br>(cu m) | COMMENTS |
|----------------|------|---------------------------|--------------------------------|--------------------|----------|
| 01472          | 1983 | Dept. Public Works Canada | Hartley Bay<br>Douglas Channel | 127 270            |          |

DUMPSITE: YAKOUN RIVER  
NO.: 143

| FILE<br>NUMBER | YEAR | PROPONENT                | LOADSITE       | QUANTITY<br>(kg) | COMMENTS   |
|----------------|------|--------------------------|----------------|------------------|------------|
| 00955          | 1980 | Dept. Fisheries & Oceans | Smithers, B.C. | 3 400            | Fertilizer |

DUMPSITE: SHINGLE POINT YUKON TERRITORY  
NO.: 144

| FILE<br>NUMBER | YEAR | PROPONENT              | LOADSITE         | QUANTITY<br>(litres) | COMMENTS          |
|----------------|------|------------------------|------------------|----------------------|-------------------|
| 01673          | 1984 | Beaufort Environmental | Tuktoyaktuk, NWT | 48                   | oil spill testing |



APPENDIX II

**PISCES IV DIVE RECORDS, 1983-1984**

- A. THORMANBY ISLAND OCEAN DUMPSITE - DECEMBER 1984
- B. MALASPINA STRAIT OCEAN DUMPSITE - DECEMBER 1984
- C. FIVE FINGER OCEAN OCEAN DUMPSITE - NOVEMBER 1983
- D. BALLENAS OCEAN DUMPSITE - NOVEMBER 1983
- E. CAPE MUDGE OCEAN DUMPSITE - NOVEMBER 1983

APPENDIX IIA.      PISCES IV DIVE RECORD

Location:      Thormanby Island      Date: 03 December 1984  
                 Ocean Dump Site  
Dive Number: 1595  
Pilot:          B. Taylor  
Observers:      H. Nelson, D. Brothers  
Position:      Start (0907 Hrs.)      Finish (1015 Hrs.)  
                 49°27.8'N      49°27.2'N  
                 124°04.4'W      124°04.7'W  
Depth:          389 metres

**SUMMARY:**

The dive commenced approximately 500 metres north-west of the dumpsite coordinates and proceeded on a course of 165° for about 1 000 metres. The bottom remained relatively flat throughout the dive and there was no indication of dumped material. This site is only used occasionally and the material dumped would normally consist of natural near-shore sediments. The bottom appeared very similar to that of the Malaspina dumpsite; however, the absence or scarcity of wood debris and associated macrobenthos i.e., squat lobster, rockfish, *Neptunea* sp., etc., was noted. The most abundant and uniformly spaced animal was the small pink shrimp typical of soft flat bottoms in the Strait of Georgia.

**OBSERVATIONS:**

During descent: at 70 metres, several small spiny dogfish (*Squalus acanthias*); at 90 metres, a band of euphausiids with numbers decreasing at 150 metres; a few northern smoothtongue, i.e., small silvery fish (*Leuroglossus* sp.); pelagic amphipods, chaetognaths, siphonophores, ctenophores.

BOTTOM

- 389 metres, soft flat bottom with fine brown sediment overlying fine grey sediment.
- core samples taken - grey, clay like lumps extracted with core.
- benthic fauna observed immediately included: small pink shrimp, sidestripe shrimp (Pandalopsis dispar), pelagic shrimp (Pasiphaea sp.), orange nemerteans.
- burrowing anemone (Pachycerianthus sp.)
- slight current from 300°.
- ratfish (Hydrolagus colliei), football anemone (Actiniaria)
- squat lobster (Munida quadrispina), brown cat shark (Apristurus brunneus), skate - snail tracks (Neptunea sp.)
- Pacific hake (Merluccius productus), eelpout

0956 hrs - 3rd core sample taken at 390 metres.

1012 hrs - 4th and final core taken at 391 metres.

1015 hrs - off the bottom - END DIVE

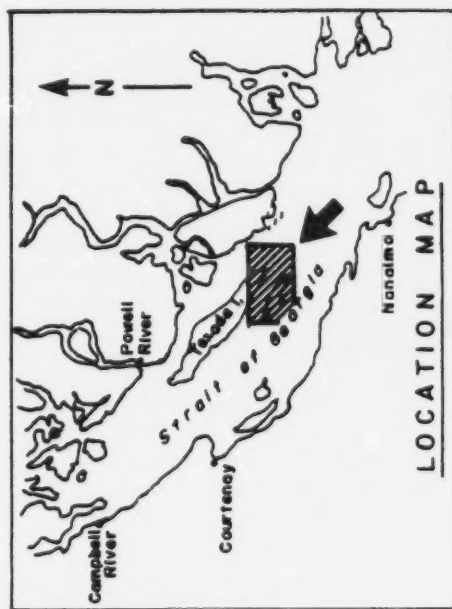
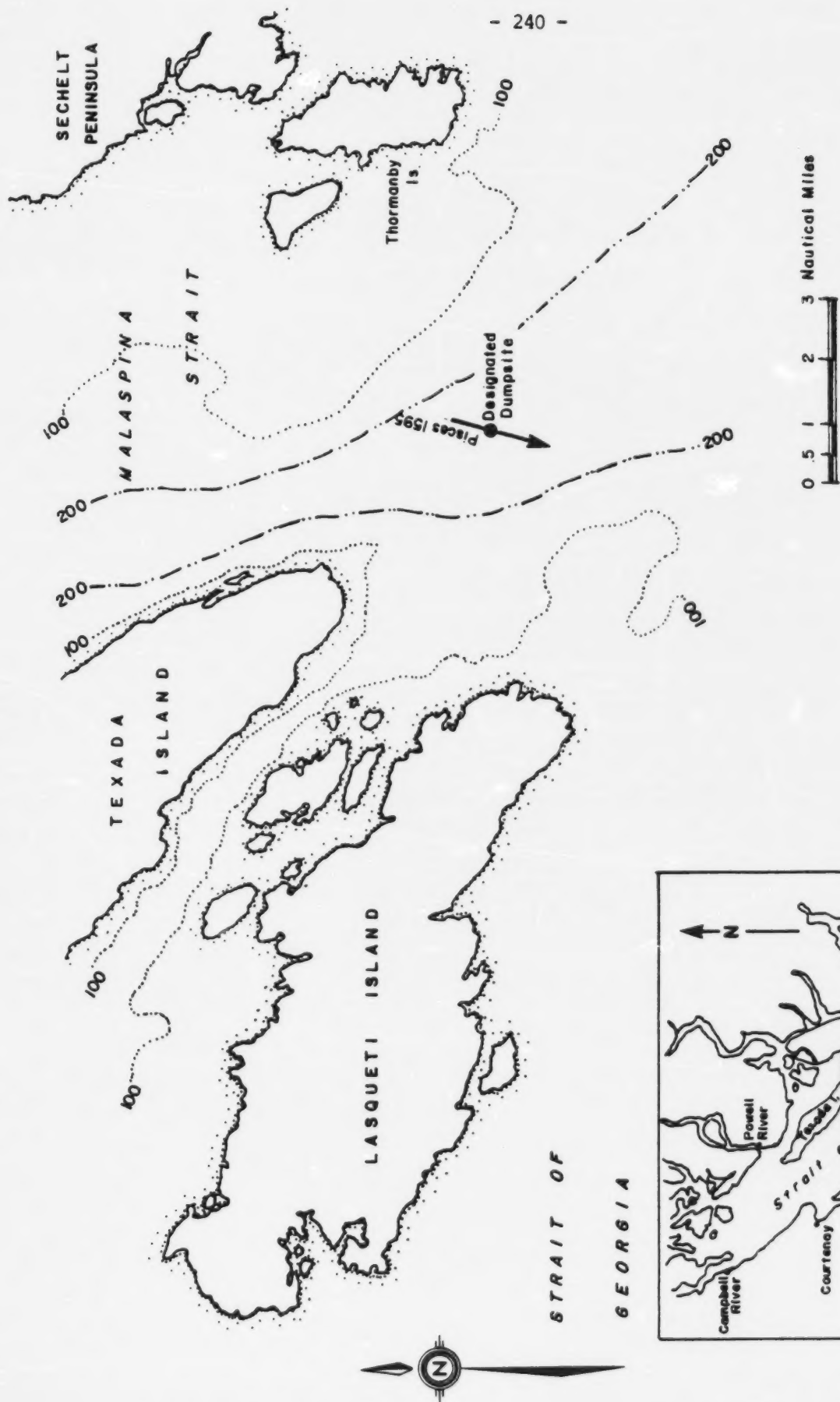


FIGURE IIA THORMANBY ISLAND OCEAN DUMPSITE - PISCES DIVE 1595 - December 1984

APPENDIX IIB.     PISCES IV DIVE RECORD

Location:     Malaspina Ocean Dump Site     Date: 01 December 1984  
                 near Pocahontas Bay,  
                 Texada Island

Dive Number: 1594

Pilot:         B. Holland

Observers:     H. Nelson, T. Tunstall

Position:     Start (1306 Hrs.)                     Finish (1504 Hrs.)

                 49°45.4'N

                 49°44.7'N

                 124°27.9'W

                 124°27.5'W

Depth:         322 metres

**SUMMARY:**

Photographic Record - 35 mm photographs (400 ASA) 35 mm slides  
                                 (200 ASA)

- Beta video tape

The dive commenced approximately 1 000 metres north-west of the dumpsite co-ordinates. The bottom at 322 metres remained flat most of the dive and was characterized by soft brown silt over grey silty-clay like sediment. Evidence of dumping activity was more pronounced towards the end of the dive with several pieces of cable, bundle ties, etc. associated with the wood debris. Many large logs, relatively recently submerged, which probably did not originate from dumping but rather were sinkers (ie Hemlock) from booms towed over the area.

The benthic community was typical for the type of bottom with much burrowing activity and common animals such as shrimp, squat lobsters, nemerteans and snails. These animals were generally in greater abundance in the areas with the most wood debris. The stringy (bacterial) slime was evident on all wood material, even recently submerged logs, and was very dense at times.

OBSERVATIONS:

During latter part of descent (250-320 metres) abundant zooplankton in water column. These included siphonophores, ctenophores, pelagic amphipods, euphausiids, small silvery fish, etc.

BOTTOM

- 322 metres, soft flat bottom with thin layer of fine brown silt overlying fine gray silt, burrowing activity with small craters surrounded by grey sediment.
- slight current from 210°, visibility 4-6 metres.
- small pink shrimp, sidestripe shrimp (Pandalopsis dispar), hake (Merluccius productus).
- headed off at course 120°, few pieces of wood debris with associated squat lobsters (Munida quadrispina) and a covering of stringy white (bacterial) slime.
- encountered some pieces of cable and bundle ties.
- several red rockfish and ratfish (Hyrolagus colliei).
- burrowing anemone (Pachycerianthus sp.), large snails (Neptunea sp.) leaving migration channels in the soft bottom sediment.
- orange Nemerteans coiled on logs and wood debris.
- small sea whips, a few large pinkish anemones (Actiniaria sp.).
- a few brown cat sharks (Apristurus brunneus), Dover sole (Microstomus pacificus), spiny dogfish (Squalus acanthias), and eelpouts.

1353 hrs - bottom unchanged, altered course to 140°.

- area of obvious dumping, three core samples taken in area of much wood debris, logs, cable, bundle ties.

1425 hrs - altered course to 200° depth unchanged.

- large pile of intertwined bundle ties.

1447 hrs - 305 m. leading up slight incline, end of Video record.

1504 hrs - END DIVE.

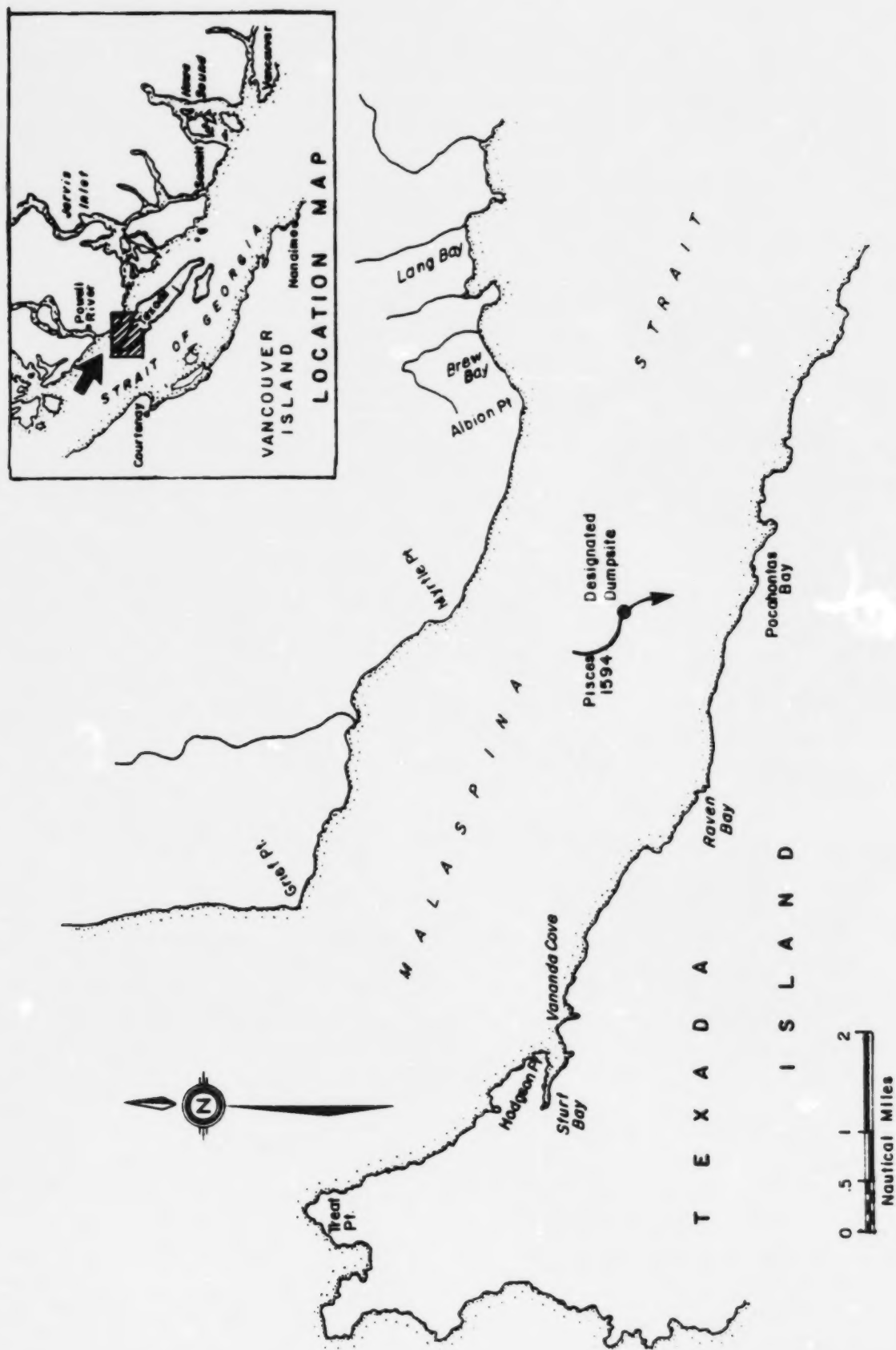


FIGURE IIB MALASPINA STRAIT OCEAN DUMPSITE - PISCES DIVE 1594 - December 1984



APPENDIX IIC.     PISCES IV DIVE RECORD

Location:     Five Finger Islands Ocean  
                 Dump Site

Date: 08 November 1983

Dive Number: 1390

Pilot:        Keith Shepherd

Observers:    D. Brother, H. Nelson

Position:     Start (1245 Hrs.)

Finish (1428 Hrs.)

49°15.4'N

49°14.7'N

123°54.7'W

123°53.5'W

OBSERVATIONS:

BOTTOM

- 307 metres

1305 hrs - current at 215°T

- flat bottom, thin layer of fine brown sediment over fine grey silt similar to Ballenas Basin
- more life evident, more burrowing activity
- squat lobster (Munida quadrispina), pink shrimp, burrowing anemones, (Pachycerianthus sp.)
- course heading 130°T
- ratfish (Hydrolagus colliei), pollock (Theragra chalcogramma), hake (Merluccius productus), Nemerteans, dogfish (Squalus acanthias), sculpins, thornyhead rockfish (Sebastolobus sp.), prawn (Pandalus platyceros), Tanner crab (Chionoecetes bairdi), many squat lobsters, skate (Raja sp.), Box crab.
- clumps of dumped material
- brown cat shark (Apristurus brunneus), several noted
- metal straps and other evidence of dumping observed. Clumps of dumped material sporadic and do not indicate any harmful effect on resident biota.

- 245 -

- 282 metres, proceed up incline
- 260 metres, solid rock face, gorgonian coral (Gorgonacea sp.)  
many rockfish

1352 hrs - typical rock face community, encrusting life forms, glass  
sponges

1410 hrs - 270 metres

- END DIVE

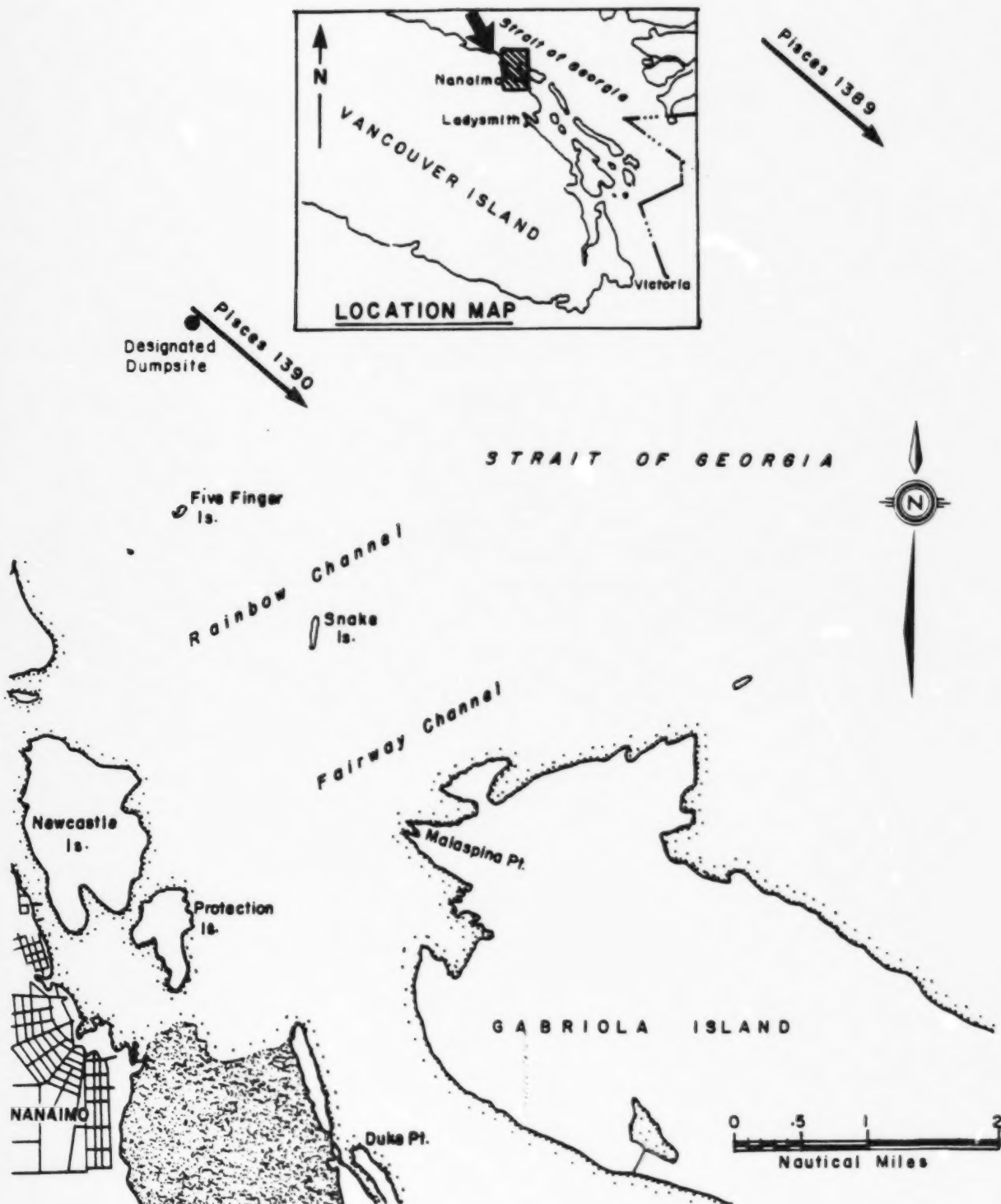


FIG. IIC and FIVE FINGER ISLAND OCEAN DUMPSITE AND BALLENAS  
FIG. IID BASIN-PISCES DIVES 1389 AND 1390 - November 1983

APPENDIX IID.     PISCES IV DIVE RECORD

Location:     Ballenas Basin Ocean     Date: 08 November 1983  
                 Dump Site  
Dive Number: 1389  
Pilot:         K. Shepherd  
Observers:     D. Brother, H. Nelson  
Position:     Start (0907 Hrs.)     Finish (1035 Hrs.)  
                 49°17.4'N                     49°16.7'N  
                 123°48.3'W                     123°47.0'W  
Depth:         407 metres

SUMMARY:

Photographic record - 8 frames  
                         - video - none

OBSERVATIONS:

BOTTOM

- 407 metres

0938 hrs - course heading 130°T.  
         - poor visibility 2 metres.  
         - flat bottom, fine brown sediment overlying fine grey material.  
         - grey sediments discharged through craters due to burrowing activities.  
         - few animals on bottom.  
         - side stripe shrimp (Pandalopsis dispar), shark (6 gills?), pink shrimp, Actinaria, eelpouts, Molpadia intermedia, burrowing anemone (Pachycerianthus sp.), Dover sole (Microstomus pacificus).

- 248 -

0955 hrs - bottom unchanged

- 406 metres

1010 hrs - bottom unchanged

- brown cat shark (Apristurus brunneus)

1013 hrs - 407 metres off bottom

- END DIVE

APPENDIX IID.     PISCES IV DIVE RECORD

Location:     Cape Mudge Ocean                     Date: 07 November 1983  
                 Dump Site  
Dive Number: 1388  
Pilot:         John Oszust  
Observers:     D. Brother, H. Nelson  
Position:     Start (1303 Hrs.)                     Finish (1525 Hrs.)  
                 49°57.7'N                             49°58.2'N  
                 125°05.0'W                             125°06.7'W

SUMMARY:

Photographic record - 24 frames

OBSERVATIONS:

BOTTOM

- 246 metres, thin layer fine brown sediment overlying sand
- slight current to north
- ratfish (Hydrolagus colliei), rockfish, shark (6 gill?), brittle stars (Ophiuroidea sp.)
- proceed at heading 295°
- squat lobster (Munida quadrispina), prawn (Pandalus platyceros), Dover sole (Microstomus pacificus)
- craters and evidence of burrowing sea anemones and burrowing anemones noted.
- few logs, bacterial/fungal growth, many sea urchins (Echinoidia sp.)

1336 hrs - rocks occasionally on soft bottom

- skate (Raja sp.)
- 253 metres
- clumps of dumped material
- prawns (P. platyceros), brittle stars (seem to be attracted to clumps of bark and wood debris)
- several ratfish (H. colliei), hake (Merluccius productus), Actinaria., pollock (Theragra chalcogramma)
- Neptunea sp. on logs
- note larger rocks and more log debris
- 224 metres
- definite evidence of dumping, oyster shells
- thornyhead rockfish (Sebastolobus sp.)
- proceed up incline; less brown, soft sediment
- seapens, white (Pennatulacea sp.)
- 200 metres
- sandy bottom
- 190 metres
- large rocks, gorgonian coral (Gorgonacea)
- glass sponge, white (Porifera)
- rockfish
- 192 metres
- begin video recording
- gravel, sand, boulders
- evidence of dumping; steel pieces, boom chains, battery
- pacific tomcod (Microgadus proximus)

1433 hrs - 180 metres

- clean grey sand and gravel, some large boulders
- sea urchins, sea pens
- current ripples in clean grey sand; sparse fauna
- sand ridges - trenches up to 3 metres between ridges filled with wood debris, broken shells, kelp, etc.



- 251 -

1433 hrs - 145 metres, current heading 180°T

1515 hrs - END DIVE

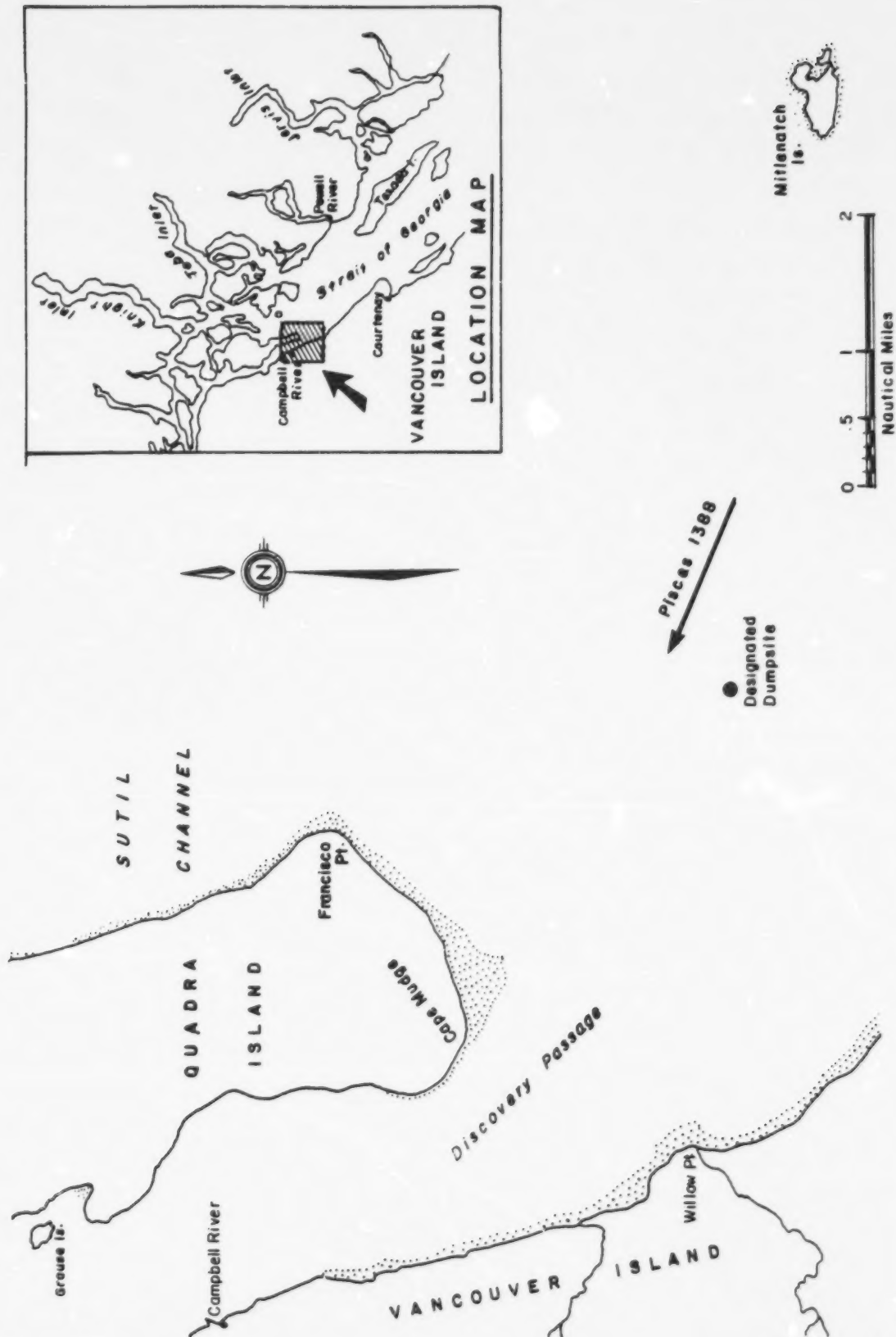


FIGURE IIE CAPE MUDGE OCEAN DUMPSITE PISCES DIVE 1388 - November 1983

APPENDIX III

ALPHABETIC LIST OF DUMP SITES  
1980-1986

APPENDIX III      ALPHABETIC LIST OF DUMP SITES

| <u>Dump Site Name</u> | <u>Co-ordinates</u>    | <u>Number</u> | <u>Page</u> |
|-----------------------|------------------------|---------------|-------------|
| Ballenas Basin        | 49°23.50'N 123°58.00'W | 115           | 100         |
| Beaver Cove           | 50°32.00'N 126°51.60'W | 136           | 184         |
| Brown Passage         | 54°18.70'N 130°45.00'W | 100           | 178         |
| Browning Entrance     | 53°44.00'N 130°32.00'W | 141           | 187         |
|                       | 53°40.00'N 130°40.00'W |               |             |
| Burrard Inlet -       |                        |               |             |
| Roche Point           | 49°17.50'N 122°57.60'W | 122           | 180         |
| Cape Lazo             | 49°42.00'N 124°50.00'W | 132           | 183         |
| Cape Mudge            | 49°57.70'N 125°05.00'W | 116           | 109         |
| Comox                 | 49°41.70'N 124°44.50'W | 48            | 59          |
| Dillingham Site       | 49°18.00'N 123°02.40'W | 124           | 181         |
| Eliza Passage         | 49°40.80'N 126°34.30'W | 118           | 157         |
| False Creek           | 49°16.50'N 123°06.30'W | 125           | 181         |
| Five Finger           | 49°15.20'N 123°54.60'W | 40            | 53          |
| French Creek          | 49°22.50'N 124°19.00'W | 44            | 58          |
| Gabriola              | 49°08.00'N 123°32.00'W | 113           | 91          |
| Ganges Harbour        | 48°50.10'N 123°26'40'W | 129           | 183         |
| Gibson's Harbour      | 49°23.90'N 123°30.20'W | 137           | 185         |
| Haro Strait           | 48°41.00'N 123°16.40'W | 18            | 43          |
| Hartley Bay -         |                        |               |             |
| Douglas Channel       | 53°25.20'N 129°14.40'W | 142           | 187         |
| Howe Sound -          |                        |               |             |
| Incineration Site     | 49°29.80'N 123°28.60'W | 139           | 186         |
| Johnstone Strait -    |                        |               |             |
| Hickey Point          | 50°27.80'N 126°04.80'W | 119           | 162         |
| Johnstone Strait -    |                        |               |             |
| Hanson Island         | 50°33.50'N 126°48.00'W | 120           | 163         |
| Kingcome Inlet        | 50°55.00'N 126°13.00'W | 75            | 115         |
| Kitimat Arm           | 53°58.00'N 128°41.50'W | 93            | 172         |
| Lambert Channel -     |                        |               |             |
| Hornby Island         | 49°30.10'N 124°41.20'W | 131           | 183         |

APPENDIX III (Continued)

| <u>Dump Site Name</u>  | <u>Co-ordinates</u>    | <u>Number</u> | <u>Page</u> |
|------------------------|------------------------|---------------|-------------|
| Little River -         |                        |               |             |
| Strait of Georgia      | 49°46.50'N 124°47.00'W | 133           | 184         |
| McNeil Bay -           |                        |               |             |
| Strait of Juan de Fuca | 48°24.60'N 123°18.30'W | 127           | 182         |
| Malaspina Hulks        | 49°51.80'N 124°33.40'W | 135           | 184         |
| Malaspina Strait       | 49°45.00'N 124°27.00'W | 49            | 60          |
| Malcolm Island         | 50°42.00'N 127°06.00'W | 121           | 167         |
| Muchalat Inlet         | 49°39.00'N 126°14.90'W | 117           | 152         |
| Newcombe Channel       | 48°54.70'N 125°29.30'W | 86            | 123         |
| North Bentinck Arm     | 52°23.00'N 126°49.00'W | 92            | 180         |
| North Pacific Ocean    | 49°25.00'N 126°20.00'W | 107           | 83          |
| Observatory Inlet      | 55°53.00'N 130°00.60'W | 110           | 188         |
| Point Grey             | 49°15.40'N 123°22.10'W | 1             | 23          |
| Porlier Pass           | 49°00.20'N 123°29.80'W | 32            | 47          |
| Porpoise Harbour       | 54°14.50'N 130°18.50'W | 97            | 180         |
| Port Alberni           | 49°12.00'N 124°49.30'W | 88            | 131         |
| Port Alice             | 50°22.70'N 127°26.60'W | 79            | 116         |
| Porteau Cove           |                        |               |             |
| Provincial Park        | 49°33.00'N 123°14.00'W | 138           | 186         |
| Prince Rupert Harbour  | 54°22.10'N 130°15.70'W | 98            | 176         |
| PWC Spoil Area 8 & 8A  | 49°15.70'N 123°16.70'W |               |             |
|                        | 49°16.40'N 123°16.70'W | 8             | 31          |
| Queen Charlotte Strait | 50°46.40'N 127°22.60'W | 140           | 186         |
| Roberts Bank -         |                        |               |             |
| Strait of Georgia      | 49°00.70'N 123°10.50'W | 126           | 182         |
| Sand Heads             | 49°06.00'N 123°19.50'W | 9             | 32          |
| Sand Head - PWC        |                        |               |             |
| Spoil Area 1           | 49°06.10'N 123°18.30'W | 9A            | 35          |
| Shingle Point, Y.T.    | 69°03.00'N 137°15.00'W | 144           | 188         |
| Swartz Bay             | 48°41.00'N 123°24.50'W | 128           | 182         |
| Tahsis Inlet           | 49°51.60'N 126°39.60'W | 83            | 117         |

APPENDIX III (Continued)

| <u>Dump Site Name</u> | <u>Co-ordinates</u>    | <u>Number</u> | <u>Page</u> |
|-----------------------|------------------------|---------------|-------------|
| Texada Island -       |                        | 136           | 185         |
| Cape Cockburn         | 49°40.40'N 124°12.20'W |               |             |
| Texada Island (West)  | 49°35.40'N 124°21.30'W |               |             |
| Texada Island (East)  | 49°38.00'N 124°17.00'W |               |             |
| Nile Creek            | 49°25.40'N 124°38.50'W |               |             |
| Thormanby Island      | 49°27.50'N 124°38.50'W | 114           | 95          |
| Thornbrough Channel   | 49°31.00'N 123°28.20'W | 64            | 69          |
| Ucluelet              | 48°53.60'N 125°32.50'W | 145           | 124         |
| Vancouver Harbour     |                        |               |             |
| Incinerator           | 49°17.20'N 123°05.80'W | 112           | 90          |
| Vancouver Harbour -   |                        |               |             |
| NHB Site              | 49°17.20'N 123°06.40'W | 123           | 181         |
| Victoria              | 48°22.30'N 123°21.80'W | 14            | 36          |
| Watts Point           | 49°38.50'N 123°14.00'W | 65            | 75          |
| Yakoun River          | 53°40.00'N 132°13.00'W | 143           | 187         |

APPENDIX IV

NUMERIC LISTINGS OF HISTORICAL AND  
EXISTING PACIFIC AND YUKON  
OCEAN DUMP SITES TO 1986



APPENDIX IV.      NUMERIC LISTING OF HISTORICAL AND EXISTING PACIFIC  
AND YUKON OCEAN DUMP SITES TO 1986

| <u>Number</u> | <u>Dump Site Name</u>                       |
|---------------|---------------------------------------------|
| 1             | Point Grey                                  |
| 2             | "Mansens' Deep", Point Atkinson             |
| 3             | Burrard Inlet, Harbour                      |
| 4             | Boulder Island, Indian Arm                  |
| 5             | Raccoon Island, Indian Arm                  |
| 6             | Annacis Island, Fraser River                |
| 7             | Fraser River, South Arm                     |
| 8             | PWC Spoil Area 8 & 8A                       |
| 9             | Sand Heads, North Arm, Fraser River         |
| 9A            | Sand Heads PWC Spoil Area 1                 |
| 10            | Sooke Harbour                               |
| 11            | Sooke Basin, Juan de Fuca Strait            |
| 12            | Race Rocks, Juan de Fuca Strait             |
| 13            | Pedder Bay, Juan de Fuca Strait             |
| 14            | Quarantine Buoy, Juan de Fuca Strait        |
| 15            | Site between Victoria and Esquimalt Harbour |
| 16            | Esquimalt Harbour                           |
| 17            | Cadboro Bay, Vancouver Island               |
| 18            | Haro Strait                                 |
| 19            | Coal Island, Saanich Peninsula              |
| 20            | Swanson Channel                             |
| 21            | Satellite Channel                           |
| 22            | Patricia Bay, Saanich Inlet                 |
| 23            | Mill Bay, Saanich Inlet                     |
| 24            | Bamberton, Saanich Inlet                    |
| 25            | Duncan, Cowichan Bay                        |
| 26            | Fulford Harbour, Saltspring Island          |

APPENDIX IV.      (Continued)

| <u>Number</u> | <u>Dump Site Name</u>                      |
|---------------|--------------------------------------------|
| 27            | Crofton, Stuart Channel                    |
| 28            | Shoal Islands, Stuart Channel              |
| 29            | Chemainus, Stuart Channel                  |
| 30            | Ladysmith                                  |
| 31            | Thetis and Kuper Islands                   |
| 32            | Porlier Pass, Dionisio Point               |
| 33            | Degnen Bay, Gabriola Island                |
| 34            | Silva Bay, Gabriola Island                 |
| 35            | Harmac, Nanaimo                            |
| 36            | Nanaimo Harbour                            |
| 37            | Departure Bay                              |
| 38            | Descanso Bay                               |
| 39            | South Snake Island                         |
| 40            | Five Finger Island, Strait of Georgia      |
| 41            | Nanoose                                    |
| 42            | Strait of Georgia, East of Ballenas Island |
| 43            | Ballenas Channel                           |
| 44            | French Creek                               |
| 45            | Qualicum Beach                             |
| 46            | False Bay, Lasqueti Island                 |
| 47            | Denman Island                              |
| 48            | Comox                                      |
| 49            | Malaspina Strait                           |
| 50            | Westview                                   |
| 51            | Blubber Bay, Texada Island                 |
| 52            | Vananda Cove, Texada Island                |
| 53            | Gillies Bar, Texada Island                 |

APPENDIX IV.      (Continued)

| <u>Number</u> | <u>Dump Site Name</u>             |
|---------------|-----------------------------------|
| 54            | Jervis Inlet, (various locations) |
| 55            | St. Vincent Bay                   |
| 56            | Vanguard Bay                      |
| 57            | Sechelt Rapids, Egmont Point      |
| 58            | Beaver Island, Sechelt            |
| 59            | Secret Cove, Sechelt              |
| 60            | Wilbraham Point                   |
| 61            | Halfmoon Bay, Sechelt             |
| 62            | Porpoose Bay, Sechelt Peninsula   |
| 63            | Gibson's Landing, Shoal Island    |
| 64            | Thornbrough Channel               |
| 65            | Watts Point                       |
| 66            | Howe Sound, Squamish              |
| 67            | Campbell River, Discovery Passage |
| 68            | Sutil Channel                     |
| 69            | Duncan Bay, Discovery Passage     |
| 70            | Menzies Bay, Discovery Passage    |
| 71            | Kelsey Bay, Johnstone Strait      |
| 72            | Beaver Cove, Johnstone Strait     |
| 73            | Port McNeil, Johnstone Strait     |
| 74            | Alert Bay, Johnstone Strait       |
| 75            | Kingcome Inlet                    |
| 76            | Pt. Hardy, Queen Charlotte Strait |
| 77            | Kains Island                      |
| 78            | Quatsino Sound                    |
| 79            | Pt. Alice, Neroutsos Inlet        |
| 80            | Holberg Inlet                     |
| 81            | Holberg Inlet                     |
| 82            | Zeballos, Zeballos Inlet          |

APPENDIX IV.      (Continued)

| <u>Number</u> | <u>Dump Site Name</u>                 |
|---------------|---------------------------------------|
| 83            | Tahsis Inlet                          |
| 84            | Zuciarte Channel                      |
| 85            | Tofino, Clayoquot Sound               |
| 86            | Newcombe Channel                      |
| 87            | Green Cove, Barkley Sound             |
| 88            | Port Alberni                          |
| 89            | West Coast, off Barkley Sound         |
| 90            | West Coast, off Cape Flattery         |
| 91            | Ocean Falls, Cousins Inlet            |
| 92            | North Bentinck Arm                    |
| 93            | Kitimat Arm                           |
| 94            | Ogden Channel                         |
| 95            | De Horsey Island, Inverness Passage   |
| 96            | Inverness Passage                     |
| 97            | Porpoise Harbour                      |
| 98            | Prince Rupert Harbour                 |
| 99            | Casey Cove, Digby Island              |
| 100           | Brown Passage, Chatham Sound          |
| 101           | Port Simpson, Tsimpsean Peninsula     |
| 102           | Dixon Entrance                        |
| 103           | Masset, Quenn Charlotte Islands       |
| 104           | Queen Charlotte City, Skidegate Inlet |
| 105           | Skidegate Channel, B.C.               |
| 106           | Selwyn Inlet, B.C.                    |
| 107           | North Pacific Ocean                   |
| 108           | North Pacific Ocean                   |
| 109           | Portland Canal                        |
| 110           | Observatory Inlet                     |
| 111           | Pauline Cove, Herschel Island, Yukon  |

APPENDIX IV.      (Continued)

| <u>Number</u> | <u>Dump Site Name</u>                                                                          |
|---------------|------------------------------------------------------------------------------------------------|
| 112           | Vancouver Harbour Incinerator                                                                  |
| 113           | Gabriola                                                                                       |
| 114           | Thormanby Island                                                                               |
| 115           | Ballenas Basin                                                                                 |
| 116           | Cape Mudge                                                                                     |
| 117           | Muchalat Inlet                                                                                 |
| 118           | Eliza Passage                                                                                  |
| 119           | Johnstone Strait - Hickey Point                                                                |
| 120           | Johnstone Strait - Hanson Island                                                               |
| 121           | Malcolm Island                                                                                 |
| 122           | Burrard Inlet - Roche Point                                                                    |
| 123           | Vancouver Harbour - NHB Site                                                                   |
| 124           | Dillingham Site                                                                                |
| 125           | False Creek                                                                                    |
| 126           | Roberts Bank - Strait of Georgia                                                               |
| 127           | McNeill Bay - Strait of Juan de Fuca                                                           |
| 128           | Swartz Bay                                                                                     |
| 129           | Ganges Harbour                                                                                 |
| 131           | Lambert Channel - Hornby Island                                                                |
| 132           | Cape Lazo                                                                                      |
| 133           | Little River - Strait of Georgia                                                               |
| 134           | Beaver Cove                                                                                    |
| 135           | Malaspina Hulks                                                                                |
| 136           | Texada Island -<br>Cape Cockburn<br>Texada Island (West)<br>Texada Island (East)<br>Nile Creek |
| 137           | Gibson's Harbour                                                                               |

APPENDIX IV.     (Continued)

| <u>Number</u> | <u>Dump Site Name</u>         |
|---------------|-------------------------------|
| 138           | Porteau Cove Provincial Park  |
| 139           | Howe Sound Incineration Site  |
| 140           | Queen Charlotte Strait        |
| 141           | Browning Entrance             |
| 142           | Hartley Bay - Douglas Channel |
| 143           | Yakoun River                  |
| 110           | Observatory Inlet             |
| 144           | Shingle Point, Y.T.           |
| 145           | Ucluelet                      |



OCEAN DUMPSITES IN SOUTHERN BRITISH COLUMBIA